

Overview



Features:

- **Retina display:** 12-inch (diagonal) Retina display
- **Ports:** 29W USB-C port and audio port. For more information, refer to article [HT204303: MacBook ports and adapters](#).
- **Input Devices:** Force Touch Trackpad and keyboard with butterfly mechanisms
- **Finishes:** Space Gray, Silver, and Gold. MacBook (Retina, 12-inch, Early 2016 and 2017) is also available in Rose Gold.

For full technical specifications, refer to AppleCare Tech Specs: support.apple.com/specs/

Important Service Considerations

This computer model's design requires special service considerations:

- **Battery safety:** Before beginning any repair procedure, read article [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).
- **Power:** The battery disconnect button is located on the logic board, and must be disengaged immediately after loosening the bottom case with battery. Refer to article [RP1212: Bottom Case with Battery](#) for instructions on how to disengage the power.
- **Data Migration:** For more information, refer to article [TP1298: Data Migration](#).
- **Trackpad Calibration:** The trackpad must be calibrated after every repair. Refer to article [TP1314: Trackpad Calibration Check](#).
- **Top case with keyboard:**
 - The top case comes with the keyboard, microphone, and Force Touch Trackpad. If any of these items need to be replaced, the top case must be replaced. If the top case is replaced, the Microphone Equalization Reset, found in AST 2, must be performed.
 - For MacBook (Retina, 12-inch, 2017) only: The keyboard has new typography. Refer to [RP1222: Top Case with Keyboard](#) for a visual.
- **Bottom case with battery:** The bottom case includes the battery. The battery cannot be removed or replaced. If the battery needs to be replaced, the whole bottom case must be replaced.
- **Logic board:** The logic board includes the memory, onboard flash storage, and wireless card. Before replacing a logic board, be sure to order an identical version of the logic board for replacement. Refer to the following articles for part numbers:

- [TP1302: Exploded View](#) for MacBook (Retina, 12-inch, Early 2015)
- [TP1447: Exploded View](#) for MacBook (Retina, 12-inch, Early 2016)
- [TP1573: Exploded View](#) for MacBook (Retina, 12-inch, 2017)
- **Audio board:** When replacing the audio board, be sure to order the correct part color.
- **Camera:** This computer has an 848-by-480-pixel resolution standard-definition (SD) camera.
- **Speaker/antenna module:** The speakers and wireless antennas are combined. The right and left speaker/antenna modules must be replaced as a pair. The Speaker Equalization Reset, found in AST 2, must be performed after the repair.
- **Lost firmware password:** It is recommended to use a USB-C to USB Adapter when recovering a lost firmware password. Refer to article [HT203409: If you lost or forgot your firmware password](#).
- **2D bar codes:** This computer includes 2D bar codes that require service providers to have updated bar code scanners. It is important to upgrade scanners to read 2D bar codes so part serial numbers can be entered in GSX. To upgrade the Motorola DS6707 scanner, refer to article [OP53: Bar Code Scanner Information and Configurations](#).
- **Ultraviolet Liquid Contact Indicators (LCIs):** MacBook (Retina, 12-inch, 2017) has Ultraviolet LCIs. Refer to article [TP1557: How to Read Liquid Contact Indicators with Ultraviolet \(UV\) Light](#) for instructions on how to view these.
- **Startup and Power:** For MacBook (Retina, 12-inch, 2017) only, there is no startup sound. Boot on Lid Open and Boot on AC Attach are two features that automatically power on the system. These features must be disabled prior to any repair that involves removing the bottom case. After the repair is complete, these features must be re-enabled. Refer to article [TP1484: Auto Boot](#).
- **Keycaps:** The keyboard on MacBook (Retina, 12-inch, 2017) has new glyphs on the Option and Control keys. Keycap kits for MacBook (Retina, 12-inch, 2017) can be used on MacBook (Retina, 12-inch, 2016), but keycap kits for MacBook (Retina, 12-inch, 2016) can not be used on MacBook (Retina, 12-inch, 2017). The keycaps for MacBook (Retina, 12-inch, 2015) are unique and not interchangeable with any other MacBook.

Fixtures and Special Tools

- Battery cover kit (076-00067)
 - MacBook Retina service stand (076-00068)
 - Trackpad calibration weights, in 200g and 800g sizes, come as a set (923-00462).
- Warning:** Do not store weights above the repair bench. Use the foam padding in which the weights are shipped for storage in tool drawers.

Cleaning Procedures

For information on how to clean the keyboard, refer to article [HT205662: Clean the keyboard of your MacBook \(Retina, 12-inch, Early 2015\) and later](#).

Use Software Update

MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) ships with a model-specific version of macOS. Refer to article [HT204319: macOS versions and builds included with Mac computers](#) to check that the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

Serial Number Location

System Serial Number

The system serial number is etched on the bottom case near the hinge.



Transferring the Serial Number

Use a fine-tip permanent marker to write the system serial number on the inside of the bottom case with battery.



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Data Migration

Data Migration on the MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

There are special considerations for data migration. It is recommended that technicians use the following procedure to transfer a customer's data from an older computer to MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017).

Note: This method is for technician use only. If a user wishes to transfer data from his or her own Mac or Windows computer, refer to article [HT204754: Move content to your new MacBook or MacBook Pro](#). For more general information on moving content to a new Mac, refer to article [HT204350: Move your content to a new Mac](#).

Required Tools:

- Host computer running OS X 10.10 Yosemite or later with the Push Migration (Version 1.1) tool installed. For more information, refer to article [TP1345: Push Migration User Guide](#).
- USB-C to USB-A cable (923-00504) to connect the MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) to the host computer.
 - **Note:** The included USB-C Charge Cable supports charging and USB 2 only. When transferring data between two MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) computers, a USB-C to USB-C cable that is capable of USB 3.1 data transfer is required.
- A Thunderbolt to Thunderbolt cable to connect the user's computer (source computer) to the host computer. If the user's computer does not have a Thunderbolt port, then a FireWire cable and a Thunderbolt to FireWire adapter will be required.



1 = Host computer
2 = Source computer
3 = Target computer

Important: For MacBook (Retina, 12-inch, Early 2016 and 2017) ensure the computer has at least 50 percent battery life before starting the migration process. If there is less than 50 percent battery power, the migration may not complete successfully.

Steps:

1. Connect the user's computer (source computer) to the host computer. **Note:** The source computer must be running OS X 10.5 Leopard or later.
2. Connect the target computer to the host computer. **Note:** Target disk mode is only supported with a USB-C to USB-A cable (923-00504).
3. Put both the source computer and the target computer into target disk mode. To do this, hold down the T key at startup. The target disk mode symbol will appear on the display of each computer.
4. Launch the Push Migration tool on the host computer.
5. Follow the prompts on the host computer to complete the data transfer.

Important:

- **For host computers running OS X 10.10 Yosemite,** the host computer must have as at least as many user accounts

as the source computer. When setting up the host computer, it is recommended to configure 10 user accounts. The user accounts do not need to have any user data in them; they only need to be configured. If there are not enough user accounts configured on the host computer, then the customer's data will not transfer.

- **For host computers running OS X 10.11 El Capitan or later**, the creation of additional user accounts is no longer needed.
- **For source computers that do not support target disk mode**, the Push Migration tool cannot be used. The migration must be performed using one of the methods described in article [HT204754: Move content to your new MacBook or MacBook Pro](#).

Auto Boot

Auto Boot for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

Boot on Lid Open and Boot on AC Attach are two features that automatically turn on the computer. These features must to be disabled prior to any repair that involves removing the bottom case. After the repair is complete, these features must be re-enabled.

Boot on Lid Open occurs when:

- the computer is shut down and you open the display to use the computer.
- the battery has enough power (otherwise the computer will show the battery charging icon).

Boot on AC Attach occurs when:

- the computer is shut down while the display is open, and then you plug in the AC power cord.
- the computer is shut down while the display is closed and an external monitor is attached, and then you plug in the AC power cord.

Important: Before you begin any repair, disable both features and unplug the computer for the duration of the repair. After the repair is complete, re-enable these features.

To disable both features before a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the last two characters are zeroes):
 - **sudo nvram AutoBoot=%00**

To re-enable both features after a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the second to last character is a zero):
 - **sudo nvram AutoBoot=%03**
6. Shut down the computer and close the display.
7. Open the display and verify that the computer turns on.

USB-C Accessories

USB-C Accessories

The MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) features one USB-C port that is used for charging as well as for data and video delivery. It is vertically symmetrical.



Caution: The USB-C port looks similar to a Lightning connector, but the two are not interchangeable. Do not attempt to insert a Lightning cable into the USB-C port.

Note: The USB-C port does not support Thunderbolt devices.

Included in the box:

- **29W USB-C Power Adapter**



- **USB-C Charge Cable**

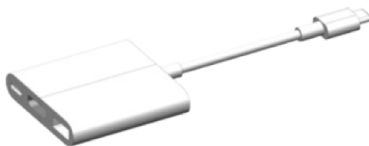
Note: The included USB-C Charge Cable supports charging and USB 2 only. When transferring data between two MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) computers, a USB-C to USB-C cable that is capable of USB 3.1 (5Gbps) data transfer is required.



Other available accessories:

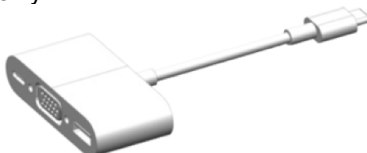
- **USB-C Digital AV Multiport Adapter**

HDMI port supports video connectivity; USB-A port supports USB 3.1 (5Gbps); USB-C port supports charge-through only.



- **USB-C VGA Multiport Adapter**

VGA port supports video connectivity; USB-A port supports USB 3.1 (5Gbps); USB-C port supports charge-through only.



Important: USB-C Digital AV Multiport Adapter and USB-C VGA Multiport Adapter may need a firmware update in order to work with MacBook (Retina, 12-inch, Early 2016 and 2017). The update can take 3–5 minutes to complete. Without the update, the computer will continuously restart when connected to an external display. For more information, refer to article [HT205858: About the USB-C Multiport Adapter Update 1.0](#).

- **USB-C to USB Adapter**

Supports USB 3.1 (5Gbps).



- **USB-C to Lightning Cable**

Supports syncing and charging of iOS devices that have a Lightning port. For more information, refer to article [HT205807: About Apple USB-C to Lightning cable](#).



Butterfly Mechanism Keycap Replacement

Butterfly Mechanism Keycap Replacement MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

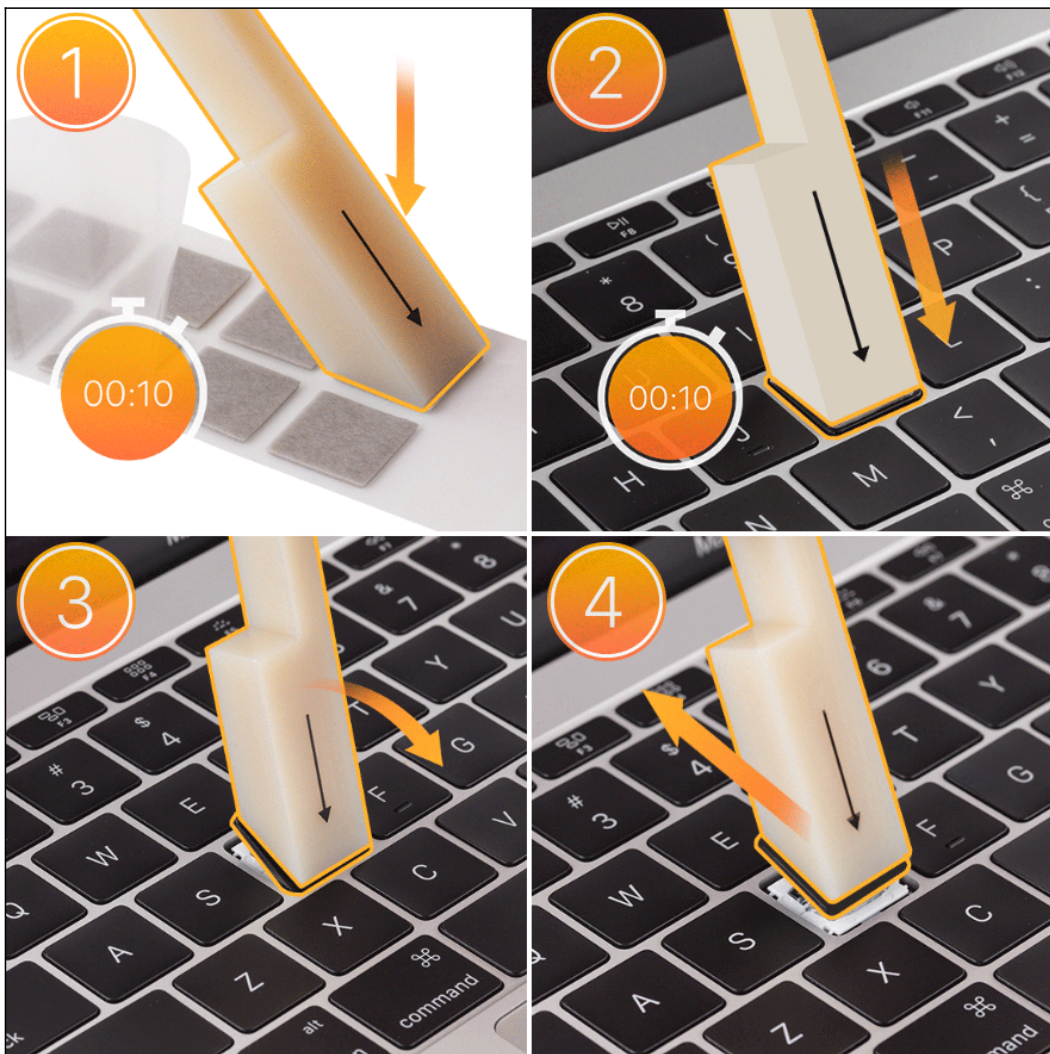
With the introduction of the keycap lever tool, keycaps for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017) computers are now easier and faster to replace. Individual keycaps should be replaced instead of the entire top case. This procedure can be done in under three minutes.

This procedure is the quickest and most cost-effective way to fix the following butterfly mechanism issues:

- Sticking keys (stuck in up or down position)
- Key press feels uneven or stiff
- Keycap not responding, is spongy, or is not going all the way down
- The key makes abnormal noise and/or is a metallic click sound
 - **Note:** For MacBook Pro (2016), first install the keycap shim to the new keycap for this issue. Refer to article [TP1550: Keycap Shim Installation](#).

The procedure involves four basic steps:

1. Applying the adhesive to the tool.
2. Pressing the tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.
4. Pushing it in the opposite direction to release hooks.



For video instruction, refer to [SV347: Portables Keycap Lever Video](#).

For part numbers, go to the [Keycap Kit Part Numbers](#) section below.

For a guide to placing the lever tool, see the [Keycap Lever Placement Map](#) below.

For detailed information on the procedure, go to the [Procedure for Removing and Replacing Keycaps](#) section below.

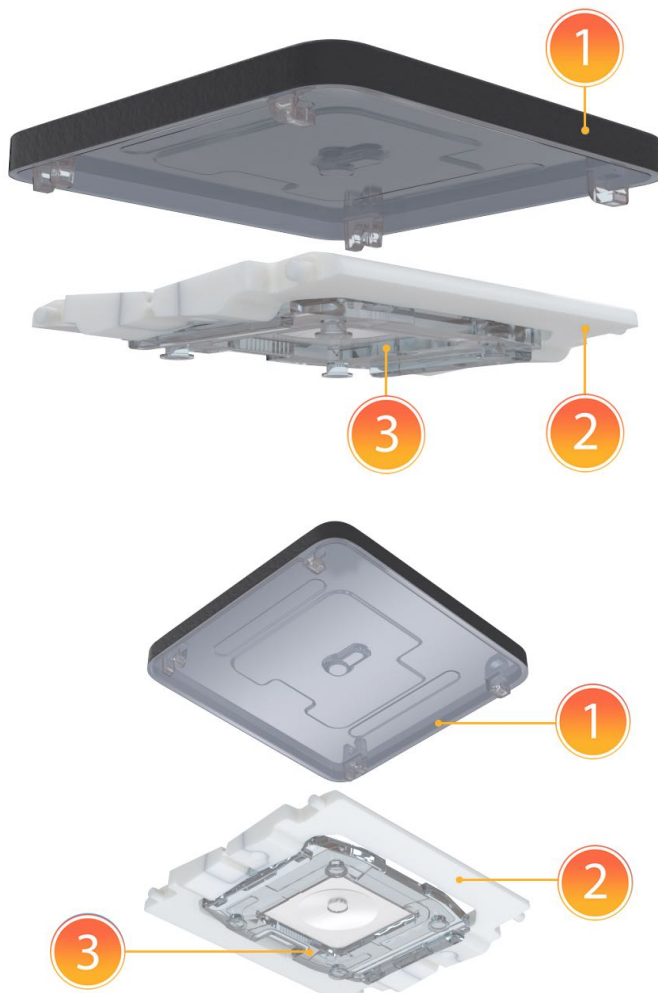
First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.
- Always use a new keycap. Do not attempt to reinstall the keycap that was removed.
- For instructions on removing and replacing the **Space bar**, refer to article [OP1469: Butterfly Mechanism Keycap Replacement](#).
- For instruction on installing a keycap shim to MacBook Pro (2016) keycaps that exhibit a loud clicking sound after the system has warmed up, refer to article [TP1550: Keycap Shim Installation](#).
- For Arabic keyboards, the return key may show uneven backlighting from top to bottom. This is expected behavior. Do not repair or replace for this issue.
- When replacing an option key, make sure the old option key and the new option key have the same glyphs. If they do not, replace both keys.

1. Keycap Anatomy

Keycap mechanisms consist of three parts. Only number 1 is replaceable:

1. Keycap, the surface key that a user sees on the keyboard
2. Butterfly, the hinged piece under the keycap
3. Switch housing, the piece that secures the butterfly to the top case



Important: Although keycaps can be replaced, the butterfly and switch housing cannot. A damaged switch housing or butterfly requires replacement of the entire top case.

If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to article [OP14: Determining and quoting accidental damage for Mac portables](#).

2. Keycap Kit Part Numbers

Important: The keycap kits vary by the computer color and the keyboard language.

To help determine keyboard localization or keycap placement, refer to article [HT201794: How to identify keyboard localizations](#).

Notes:

- Keycap kits are available for UK English (ISO), U.S. English (ANSI), Chinese (ANSI) and Japanese (JIS) version keyboards.
- The **Super ISO** is a European special character kit that includes specific keycap characters for:
 - German (D)
 - French (F)
 - Danish (DK)
 - Italian (T)
 - Spanish (E)
 - Swedish (S)
- **Common Kits** include:
 - ANSI - space bar, left and right shift, caps lock, delete, tab, return, escape
 - JIS - space bar, return, left and right shift, #1, power
 - ISO - space bar, right shift, caps lock, delete, tab, return, escape

MacBook Pro (13-inch, 2016, 2 Thunderbolt 3 Ports)

Part Number	Label Number	Language	Computer Color
923-01088	605-01344	ANSI English	Space Gray
923-01089	605-01345	ANSI English	Silver
923-01661	605-02130	ANSI English Common Kit	Space Gray
923-01660	605-02129	ANSI English Common Kit	Silver
CH923-01088	CH605-01344	ANSI English, China	Space Gray
CH923-01089	CH605-01345	ANSI English, China	Silver
B923-01088	B605-01344	ISO English	Space Gray
B923-01089	B605-01345	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO English	Space Gray
ZM923-01089	ZM605-01345	Super ISO English	Silver
ZM923-01661	ZM605-02130	ISO English Common Kit	Space Gray
ZM923-01660	ZM605-02129	ISO English Common Kit	Silver
J923-01088	J605-01344	Japanese	Space Gray
J923-01089	J605-01345	Japanese	Silver
J923-01661	J605-02130	Japanese Common Kit	Space Gray
J923-01660	J605-02129	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2016, 4 Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016)

Part Number	Label Number	Language	Computer Color
923-01454	605-01811	ANSI English	Space Gray
923-01455	605-01812	ANSI English	Silver
923-01663	605-02132	ANSI English Common Kit	Space Gray
923-01662	605-02131	ANSI English Common Kit	Silver
CH923-01454	CH605-01811	ANSI English, China	Space Gray
CH923-01455	CH605-01812	ANSI English, China	Silver
B923-01454	B605-01811	ISO English	Space Gray
B923-01455	B605-01812	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO, English	Space Gray
ZM923-01089	ZM605-01345	Super ISO, English	Silver
ZM923-01663	ZM605-02132	ISO English Common Kit	Space Gray
ZM923-01662	ZM605-02131	ISO English Common Kit	Silver
J923-01454	J605-01811	Japanese	Space Gray
J923-01455	J605-01812	Japanese	Silver
J923-01663	J605-02132	Japanese Common Kit	Space Gray
J923-01662	J605-02131	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2017) and MacBook Pro (15-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01849	605-03030	ANSI English	Space Gray
923-01850	605-03031	ANSI English	Silver
923-01857	605-03034	ANSI English Common Kit	Space Gray
923-01858	605-03035	ANSI English Common Kit	Silver
CH923-01849	CH605-03030	ANSI English, China	Space Gray
CH923-01850	CH605-03031	ANSI English, China	Silver
B923-01849	B605-03030	ISO English	Space Gray
B923-01850	B605-03031	ISO English	Silver
ZM923-01857	ZM605-03034	ISO English Common Kit	Space Gray
ZM923-01858	ZM605-03035	ISO English Common Kit	Silver
J923-01849	J605-03030	Japanese	Space Gray
J923-01850	J605-03031	Japanese	Silver
J923-01857	J605-03034	Japanese Common Kit	Space Gray
J923-01858	J605-03035	Japanese Common Kit	Silver

MacBook (Retina, 12-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01730	605-02311	ANSI English	Space Gray
923-01731	605-02312	ANSI English	Silver, Gold, Rose Gold
923-01732	605-02313	ANSI English Common Kit	Space Gray
923-01733	605-02314	ANSI English Common Kit	Silver, Gold, Rose Gold
CH923-01730	CH605-02311	ANSI English, China	Space Gray
CH923-01731	CH605-02312	ANSI English, China	Silver, Gold, Rose Gold
B923-01730	B605-02311	ISO English	Space Gray
B923-01731	B605-02312	ISO English	Silver, Gold, Rose Gold
ZM923-01730	ZM605-02311	Super ISO, English	Space Gray
ZM923-01731	ZM605-02312	Super ISO, English	Silver, Gold, Rose Gold
ZM923-01732	ZM605-02313	ISO English Common Kit	Space Gray
ZM923-01733	ZM605-02314	ISO English Common Kit	Silver, Gold, Rose Gold
J923-01730	J605-02311	Japanese	Space Gray
J923-01731	J605-02312	Japanese	Silver, Gold, Rose Gold
J923-01732	J605-02313	Japanese Common Kit	Space Gray
J923-01733	J605-02314	Japanese Common Kit	Silver, Gold, Rose Gold

3. Keycap Lever Placement Map

The following illustrations show where to place the keycap lever when removing keycaps.

Release the edge of the keycap at the snaps before releasing the edge with the hooks. For detailed instructions, go to the [Procedure](#) section below.



Yellow: The hooks are on the bottom and the snaps are on the top.



Blue: The hooks are on the right and the snaps are on the left.



Orange: There are four snaps on top and four hooks on the bottom.



Purple: The hooks are on the left and the snaps are on the right.



Green: There are three hooks on the bottom and three snaps on the top.



Light Orange: There are three hooks on the right and three snaps on the left.



Pink (Japan only): The hooks are on the top and the snaps are on the bottom.

Click on the image below to enlarge it.

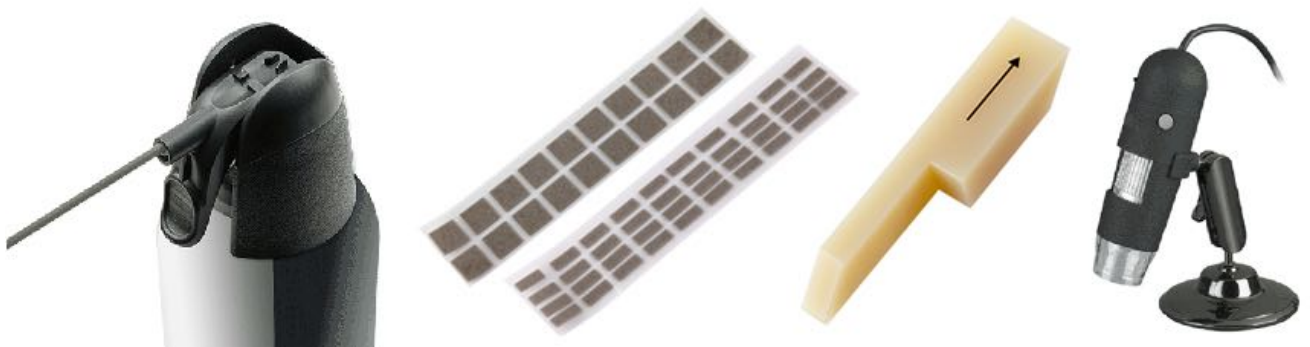


4. Procedure for Removing and Replacing Keycaps

Caution:

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB. The top case should not bend when pressing the keycap lever tool onto the keycap. Too much pressure can damage the butterfly resulting in a full top case replacement.
- If the butterfly is damaged, a full top case replacement is required.
- Inspect the switch housing with a USB microscope. If the pockets are damaged, a full top case replacement will be required. Refer to step 9 of Section 4A.

Tools:



- Compressed air
- Pre-cut VHB adhesive strips (923-01801, 1x1; 923-01800, 1x.5)

- Keycap lever (923-01803) **Note:** This tool is double-sided. The large side is for yellow, pink, and green keys; the smaller side is for blue, light orange, and purple keys. This tool is not to be used for the space bar (orange keys).
- USB Microscope
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips

Note: Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.

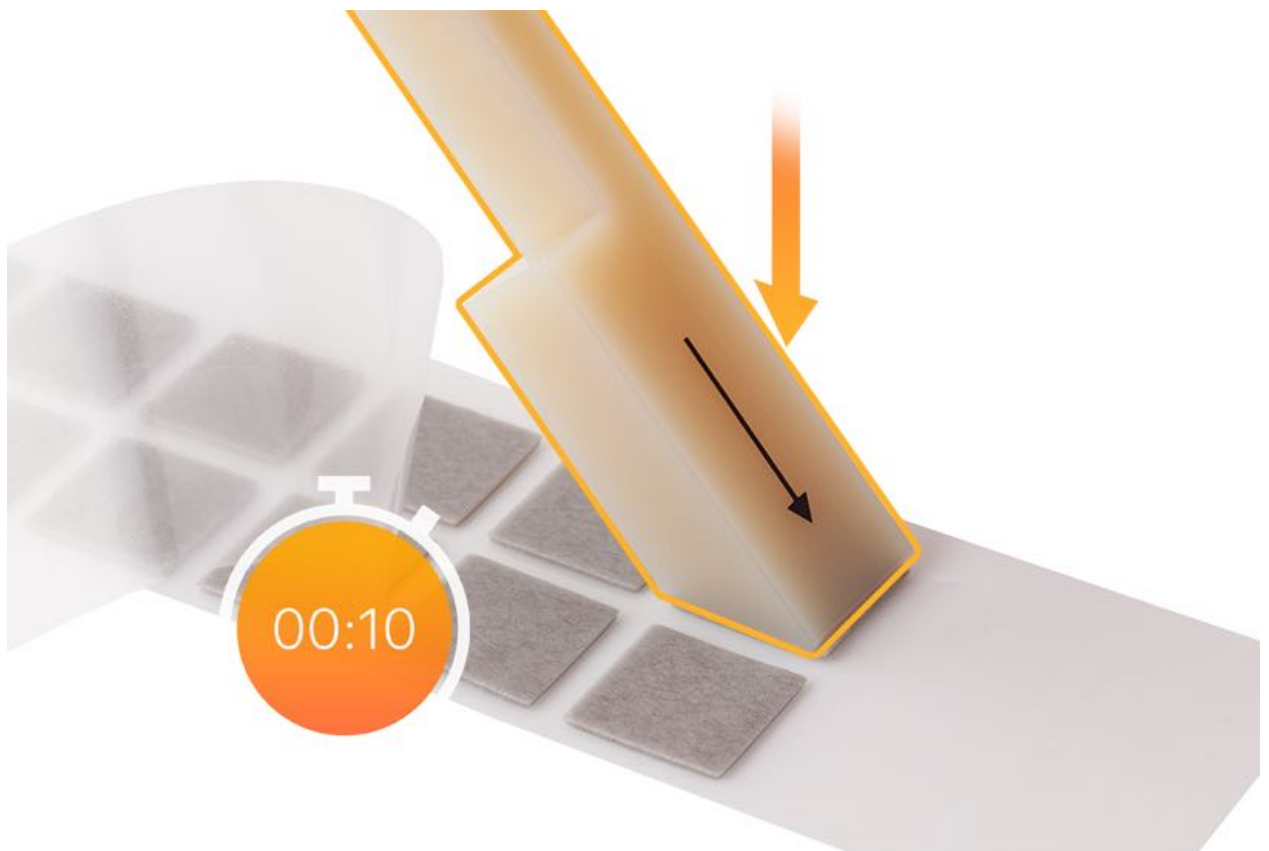
Follow these steps to remove and replace a keycap.

There are four types of keys on the keyboard. Each type requires a different procedure.

- For instructions on removing and replacing the **Space bar**, refer to article [OP1469: Butterfly Mechanism Keycap Replacement](#).

A. Removing and Replacing Yellow, Green, and Pink Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the large end of the keycap lever tool onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.
3. Lightly press the tool with the adhesive side down, onto the key, aligning the arrow on the tool with the hooks on the keycap. See the keycap map for location of hooks.

Note:

- On the larger keys such as caps lock, return, shift, tab, delete, command, place the tool in the middle of the key.
- If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.



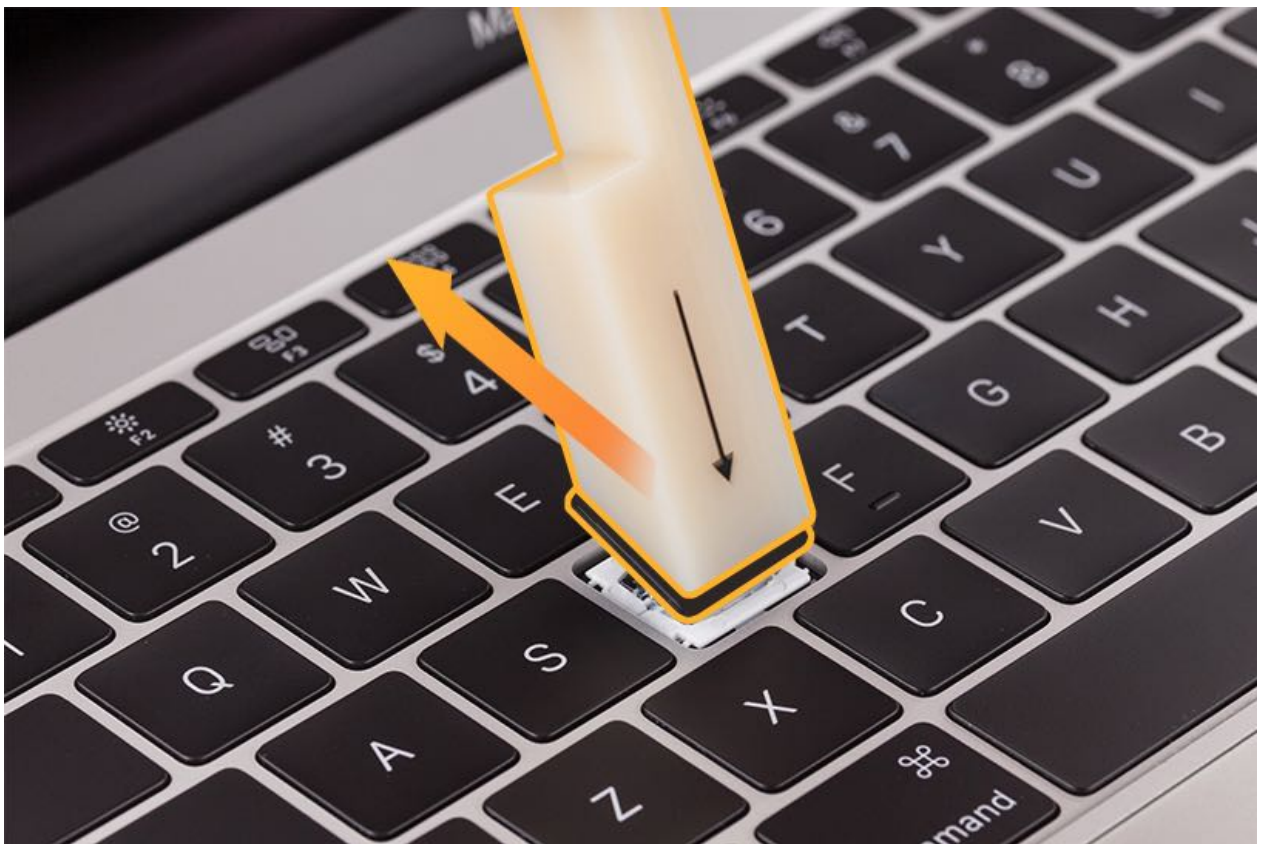
4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever away from the display to unsnap the keycap. Stop when you hear a click.



6. Then push the lever tool up towards the display to unhook the keycap hooks and remove the keycap.



7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

8. Visually inspect the keycap well for debris or foreign objects. If debris is found, use compressed air to clean the keycap well. **Note:** If the debris is visible and compressed air does not dislodge it, use a black stick to gently dislodge the debris.

9. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of

place.

10. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



11. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

12. Always replace the keycap with a new one. Do not reuse keycaps. Insert the bottom of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

13. Gently push down on the top of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

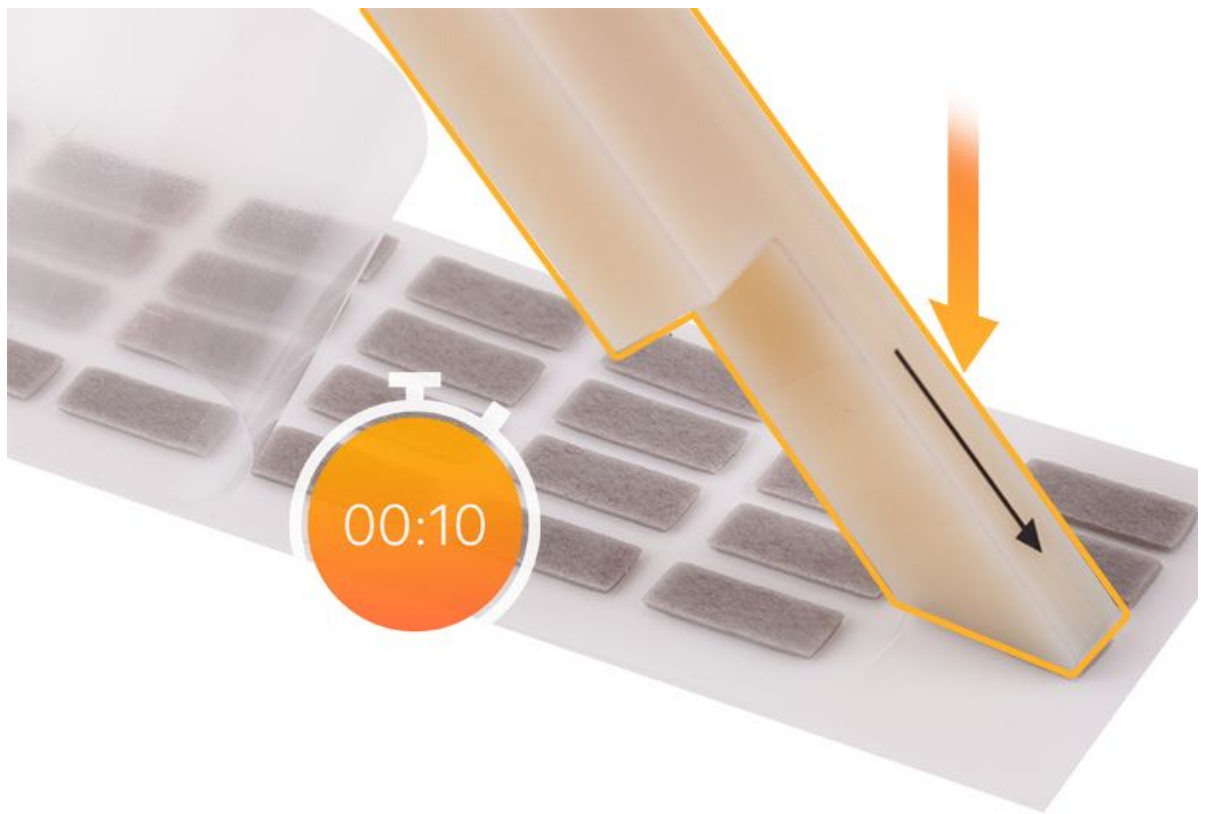
14. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

15. When replacing the option key, check to make sure both keys have the same glyphs. If the new option key is different from the old one, replace both keys.

B. Removing and Replacing the Up Arrow Keys (Purple), ISO and JIS Return Keys (Light Orange), and the Function and Down Arrow Keys (Blue)

Steps for Removing the Up Arrow Key

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the up arrow key, aligning the arrow with the hooks on the left side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.



5. Pull the lever to the left to unsnap the keycap. Stop when you hear a click.



6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.

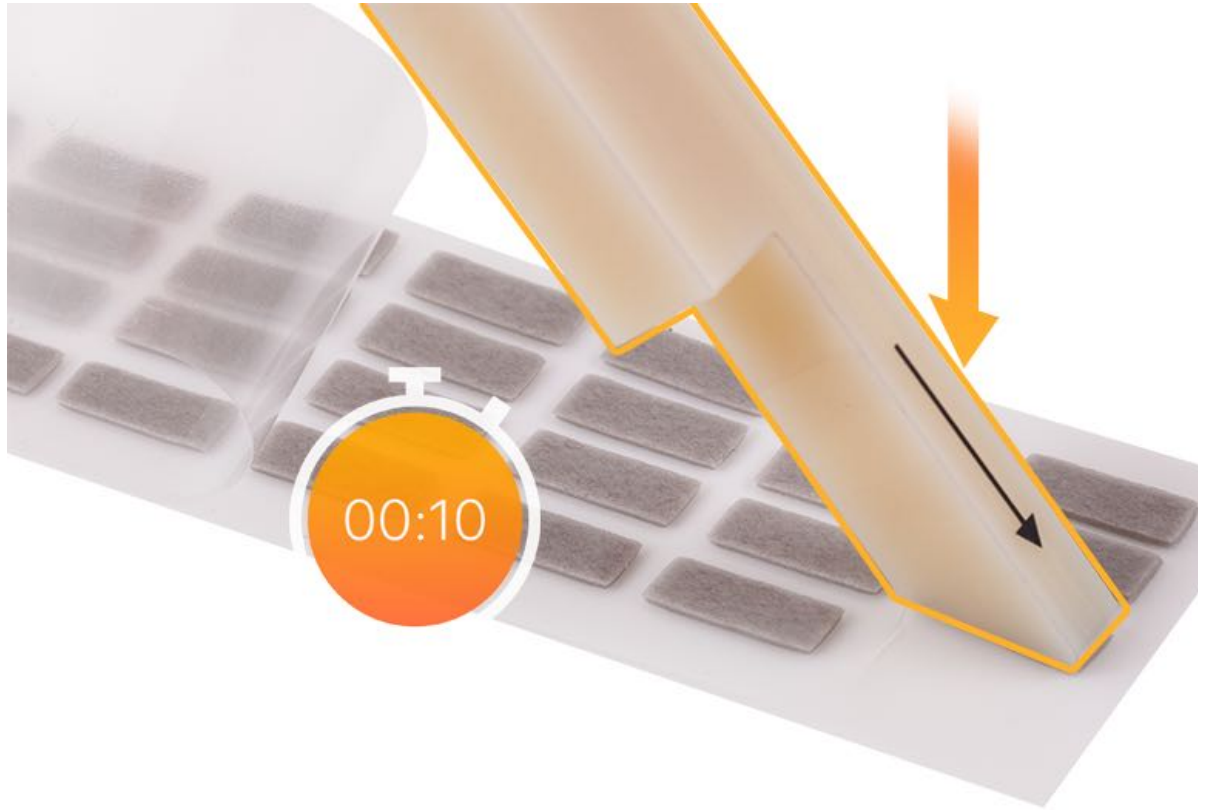


7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Steps for Removing the Down Arrow, JIS and ISO Return, and Function Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of

the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the down arrow key or function key, aligning the arrow with the hooks on the right side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

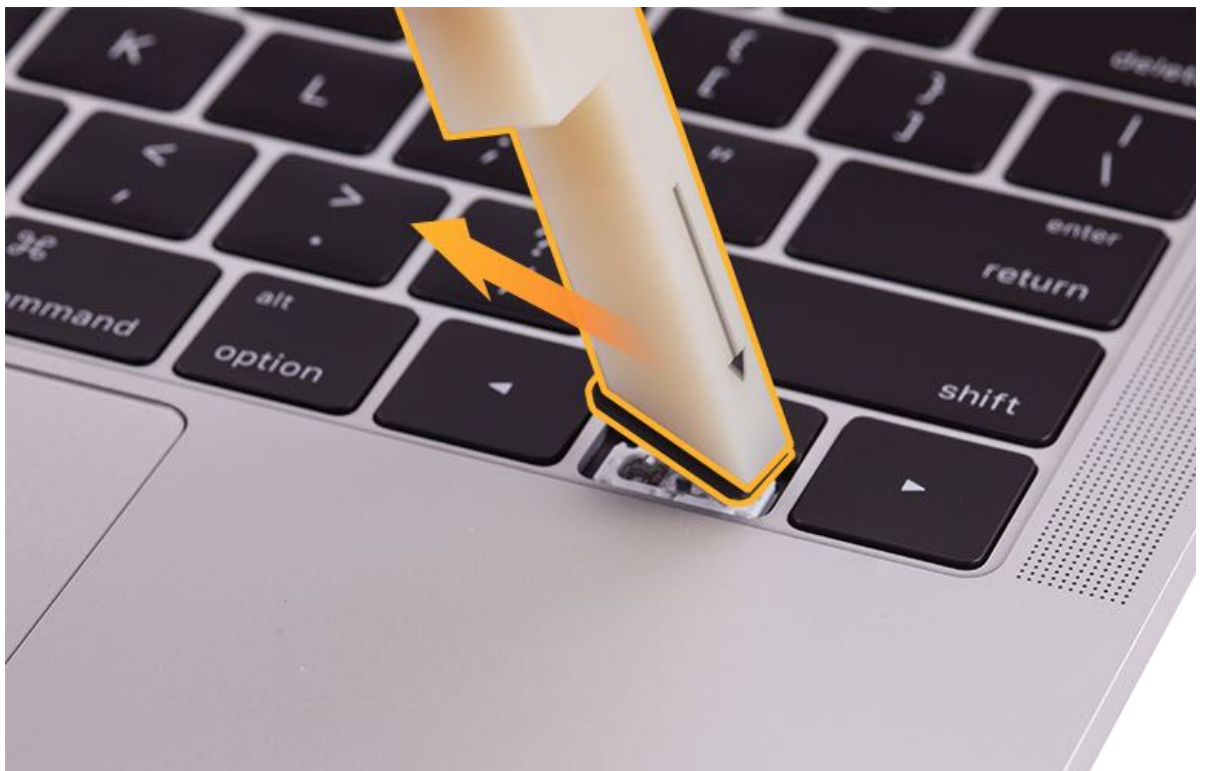
4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever to the right to unsnap the keycap. Stop when you hear a click.



6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.



7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Replacing the Arrow Keys, JIS and ANSI Return Keys, and Function Keys

1. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.
2. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



3. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.
4. Always replace the keycap with a new one. Do not reuse keycaps.
 - For the up arrow, insert the right side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
 - For the down arrow and function keys, insert the left side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
5. Gently push down on the left side of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.
6. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

- [Mac Displays](#)
- [Liquid Damage](#)
- [Power Adapters](#)
- [USB-C Cables](#)

Liquid Contact Indicators

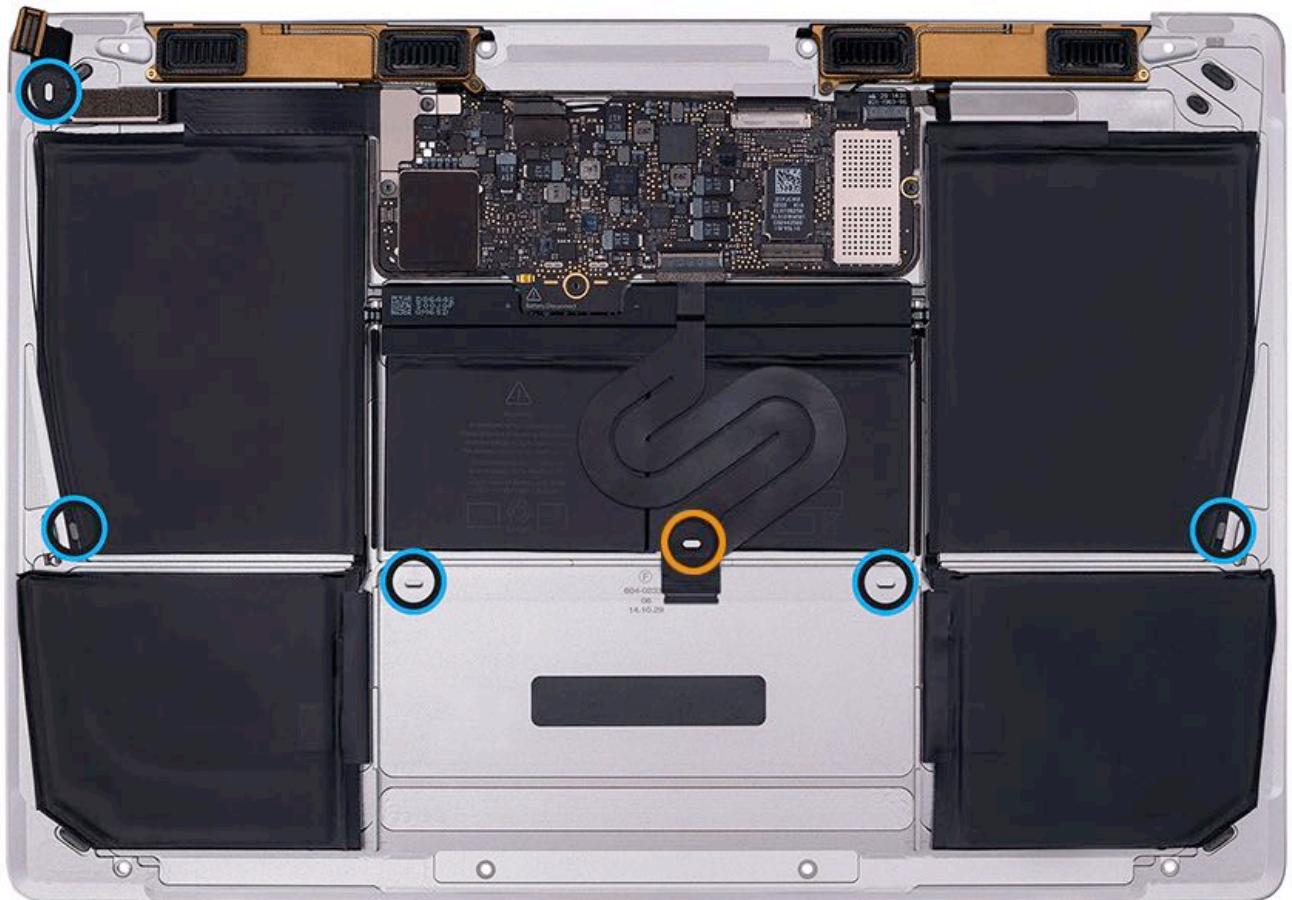
Liquid Contact Indicators for MacBook (Retina, 12-inch, Early 2015 and Early 2016)

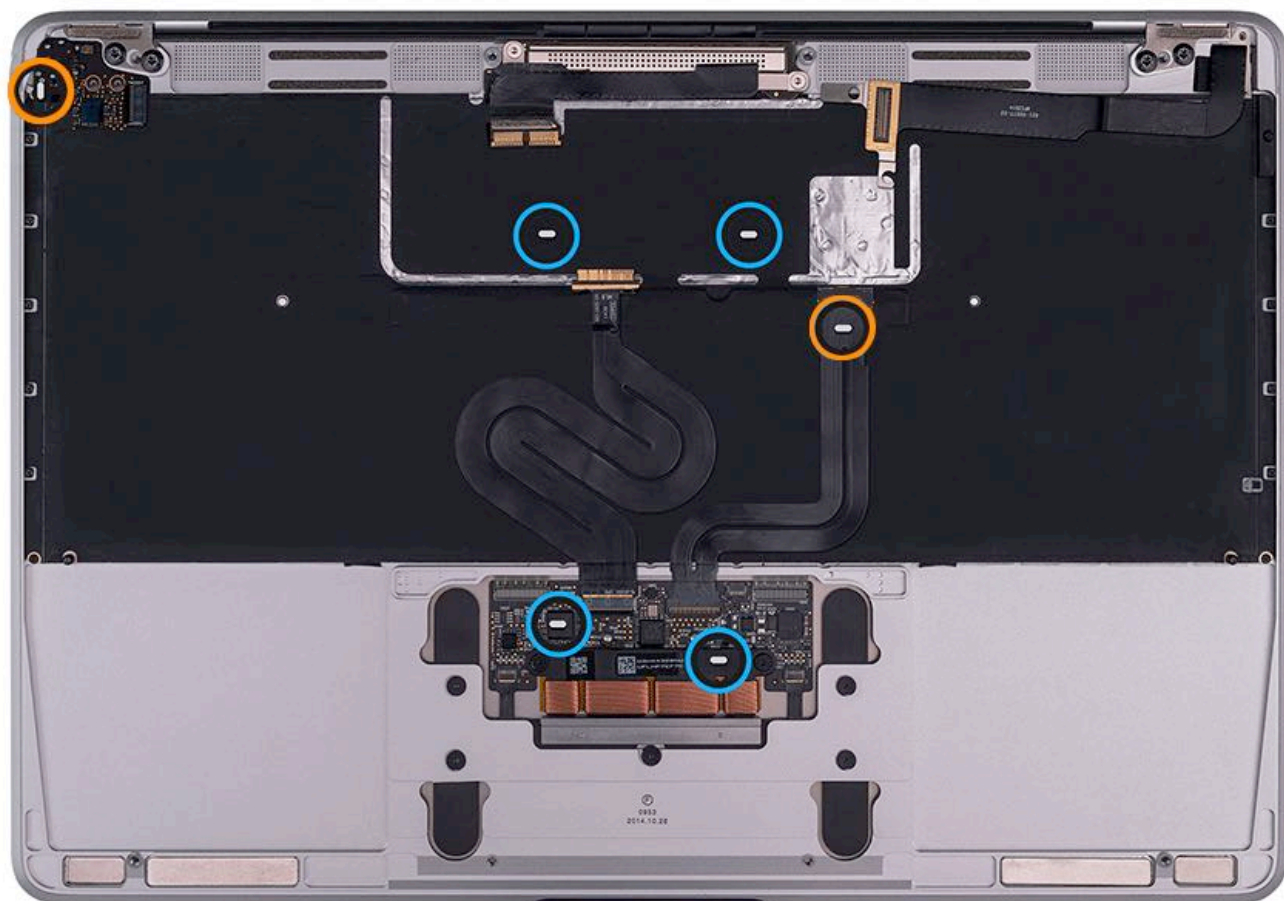
The top case includes spill sensors called liquid contact indicators (LCIs) to help discover accidental damage to the computer. The sensors are visible only when the bottom case and most of the modules have been removed. Normally represented by small white dots, the LCIs turn red when they have come in contact with liquid, such as an accidental spill.

For more information, refer to article [HT204769: Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#).

The following image shows the general location of the LCIs in this computer. **Note:** The images below are of MacBook (Retina, 12-inch, Early 2015). Components in later models may look slightly different. For internal views of MacBook (Retina, 12-inch, Early 2016), refer to article [TP1306: Internal Views](#).

Note: In some computers, the LCIs circled in orange are black and will not present a visible change when triggered by liquid. If the computer you are working with has these black LCIs, disregard them.





How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

MacBook (Retina, 12-inch, 2017) includes spill sensors called liquid contact indicators (LCIs) to help discover accidental damage to the computer. The sensors are black and liquid contact is only visible with the use of a UV light. The sensors will appear black under normal light and will glow blue when highlighted with a UV light. The LCIs will turn pink or show a pink halo when they have come in contact with liquid.

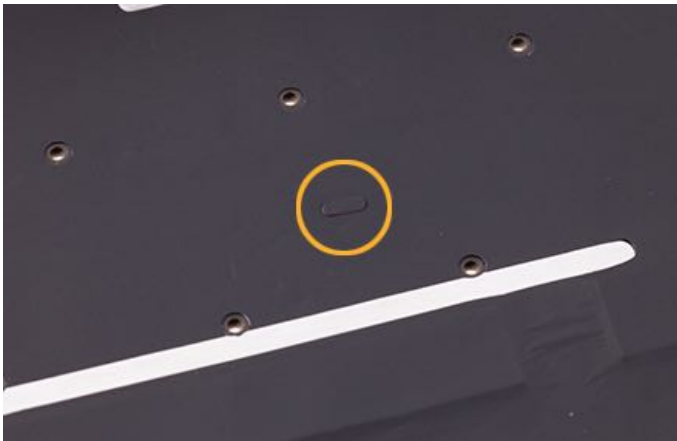
For more information, refer to article [HT204769: About liquid contact indicators \(LCIs\) and warranty coverage](#).

For video instruction, refer to article [SV348: Using UV Light to Read LCIs Video](#).

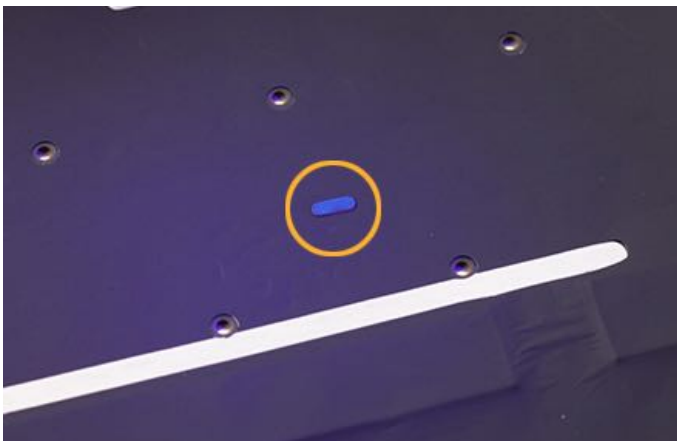
Important: A triggered LCI is not the only evidence of liquid contact. Be sure to inspect for corrosion or liquid residue during a quick check or repair. Refer to article [TP1150: Visual/Mechanical Inspection \(VMI\) Guide for Mac Portables Liquid Damage](#) for instructions on how to inspect for liquid damage.

No Liquid Contact:

- Without UV light

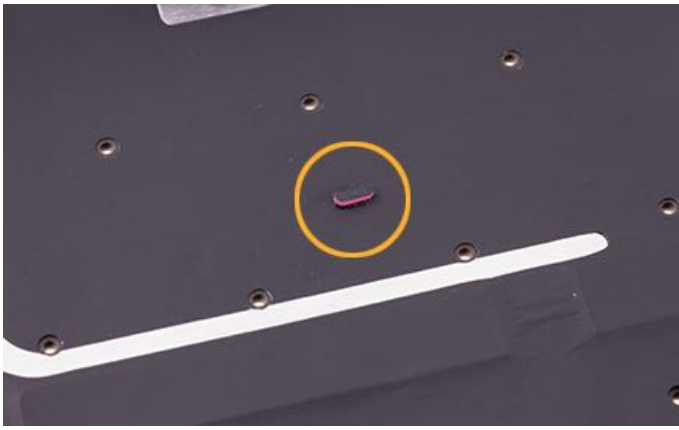


- With UV light

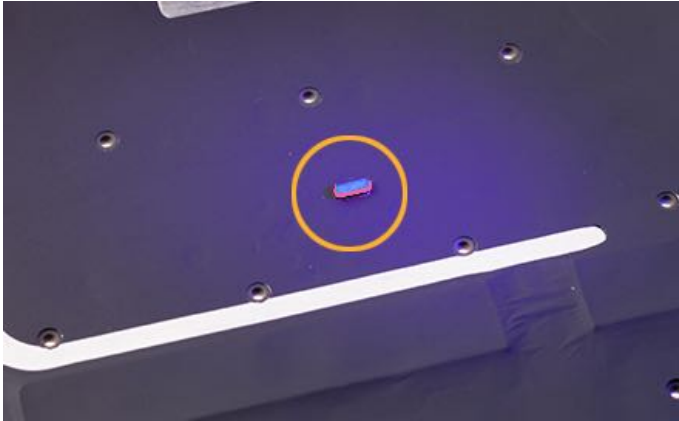


Liquid Contact:

- Without UV light



- With UV light



Safety Information:

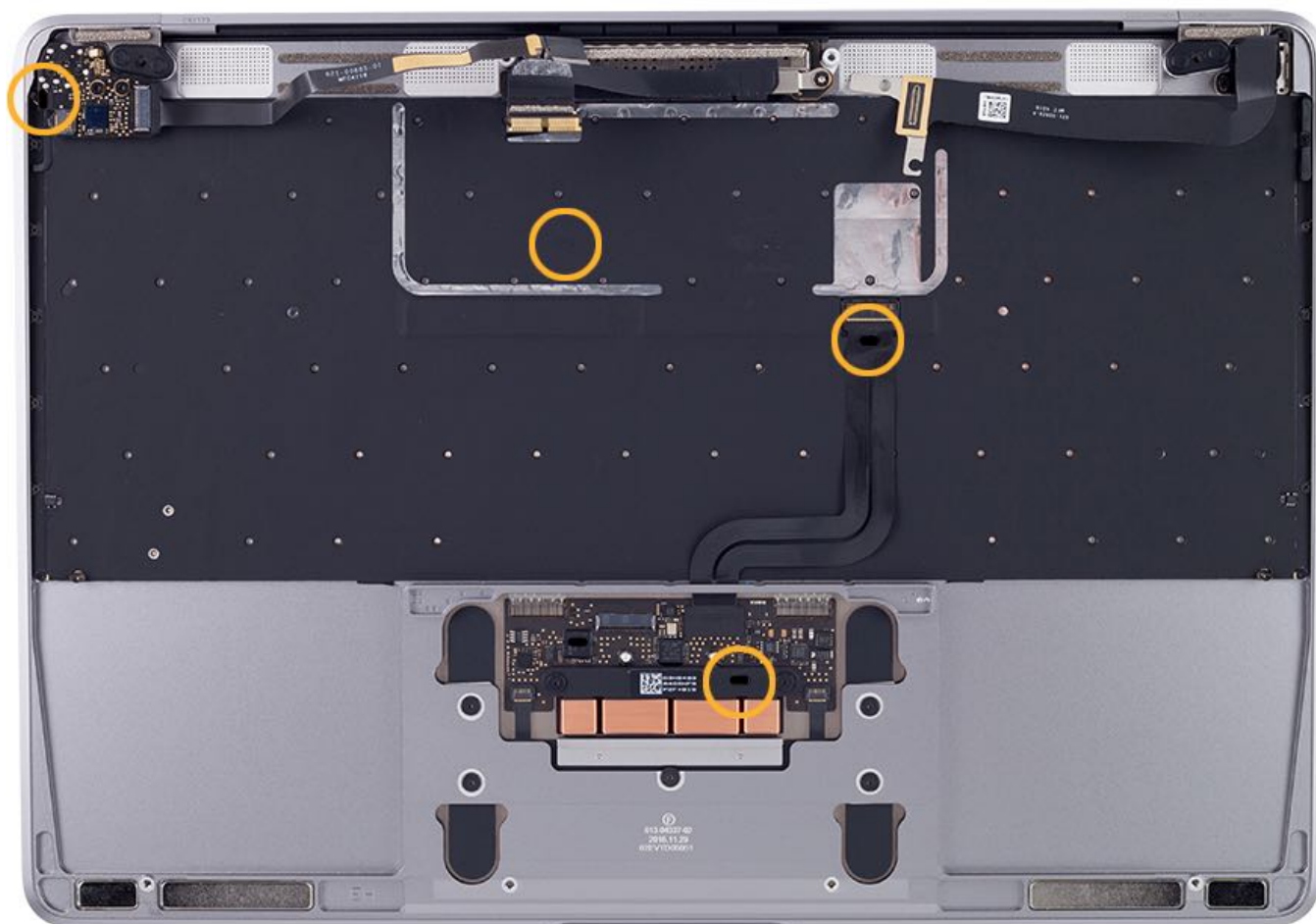
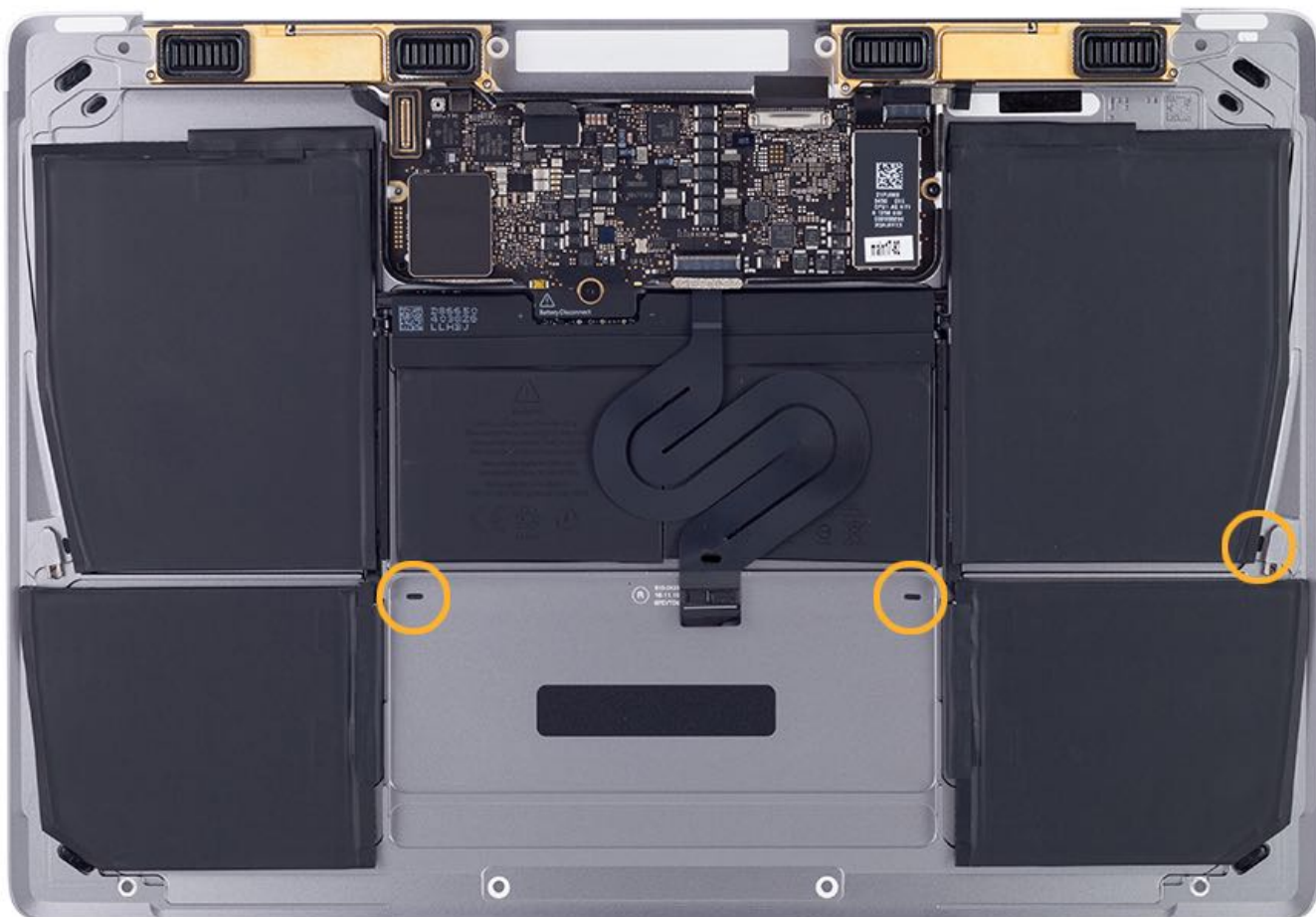
Caution: LCIs on the MacBook (Retina, 12-inch, 2017) become visible by using the Apple approved UV light. There are safety considerations when using this tool:

- The UV light has warning labels attached. Do not remove these labels.



- Do not shine the UV light in anyone's eyes or face.
- Avoid repeated exposure to the UV light.
- If a different UV light is used, safety glasses and gloves must be worn to avoid excessive exposure.

The following image shows the general location of the LCIs in this computer.



Procedure

Note:

- The LCIs on the MacBook (Retina, 12-inch, 2017) are black and blend in with the rest of the computer. When in contact with liquid, the LCIs may swell and be easier to identify.
- When using the UV light, hold it 12–14 inches (30–35 cm) from the computer and shine it at an angle of 15 to 75 degrees.
- **Warning:** While the UV light is shining, do not hold it close to your face or bend your head down to look closely at the LCIs.



1. Press the power button on the UV light.



2. Check the color of the LCI. Blue indicates a LCI that has not been triggered. A pink LCI or a pink halo around the LCI indicates that it has been triggered. Refer to the chart at the top of this article for visual examples.

LCD Pixel Anomalies

When displaying a single color over the screen area, the LCD panel might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels—red, green, and blue—that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning that subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on the LCD panel. For example, the LCD panel used in the iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means that there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, which results in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest quality LCD panels in its products; however, pixel anomalies can occur in a small percentage of panels.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped somewhere inside the display or on the front surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the outer surface of the display or glass panel can be easily removed using a lint-free cloth.
- For iMacs only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or Apple Retail Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

- [HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later](#)
- [HT201613: About LCD display pixel anomalies for Apple products released before 2010](#)

General Troubleshooting

Update Software and Firmware

Important: Before you begin troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the wrong version of macOS system software is installed. Check article [HT204319: macOS versions and builds included with Mac computers](#) to make sure system build is correct for this computer model.

Firmware is the name given to software that is written into memory circuits such as flash memory, that will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel Mac computers is designed to be updated if necessary by running the macOS Software Update check (available in the Apple () menu) while the computer is connected to the Internet.

For more information about firmware updates, refer to article [HT201518: About EFI and SMC firmware updates for Intel-based Mac computers](#).

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware vs. Software

To isolate a hardware issue from a software issue, refer to article [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS](#)
- [HT202574: Mac mini \(Late 2012 and later\), iMac \(Late 2012 and later\): About Fusion Drive](#)

Quick Check Procedures

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to article [HT201295: Reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMacs: If the power button is pressed while inserting the power cord, the iMac will enter a mode in which the fans run at full speed. For more information, refer to article [HT204463: iMac: Fans run at full speed after computer turns on](#).

Resetting Non-Volatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer as well as the types of devices and drives connected. To reset NVRAM:

1. Shut down the computer.
2. Locate the following keys on the keyboard: Command, Option (Alt), P, and R. You will need to hold these keys down simultaneously in Step 4.
3. Press power button.
4. Immediately press and hold Command-Option-P-R keys.
Important: You must press this key combination before the gray screen appears.
5. Hold down keys until computer restarts, and you hear startup chime a second time.
Note: For MacBook Pro (Late 2016 and 2017) and MacBook (Retina, 12-inch, 2017), hold down keys for at least 20 seconds. There is no startup chime.
6. Release keys.

Note: After resetting NVRAM, you might need to reconfigure settings for speaker volume, screen resolution, startup disk selection, and time zone information.

For more information, refer to article [HT204063: How to Reset NVRAM on your Mac](#).

Starting Up in Safe Mode

Safe Mode (sometimes called Safe Boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

Follow these steps to start up into Safe Mode:

1. Be sure the computer is shut down.
2. Press the power button.
3. Press and hold the Shift key.
Note: The Shift key should be pressed as soon as possible after the power button is pressed.
4. Release the Shift key when you see the Apple logo appear on the screen. After the Apple logo appears, it may take longer than usual to reach the login screen. This is because the computer is performing a directory check as part of Safe Mode.
5. To leave Safe Mode, restart the computer without pressing any keys during startup.

For more information, refer to article [HT201262: Use Safe Mode to isolate issues with your Mac](#).

Recovering a Lost Firmware Password

Only Apple Retail Stores or Apple Authorized Service Providers can unlock the following Mac models when protected by a firmware password:

- iMac (Mid 2011 and later)
- MacBook (Retina, 12-inch, Early 2015 and later)
- MacBook Air (Late 2010 and later)
- MacBook Pro (Early 2011 and later)
- Mac mini (Mid 2011 and later)
- Mac Pro (Late 2013)

Refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

Sleep Status Tips

Sleep Status Tips for MacBook (Retina, 12-inch, Early 2015 and later) and MacBook Pro (2016 and later)

These computer models do not have a sleep LED. To troubleshoot without one:

- Press and hold the Caps Lock key to wake the computer from sleep. The Caps Lock LED is a good indication of power.
- Check the haptic response of the trackpad. The trackpad will not have any haptic response when there is no power to the system.
- Open the display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been asleep for an extended period can consume the remaining charge of the battery. Restore power to the computer with a known-good power adapter.
The computer will start up from a hibernation file and start up from where it left off.
- Use an Apple USB-C to USB Adapter, Apple USB-C Digital AV Multiport Adapter, or an Apple USB-C VGA Multiport Adapter to connect a USB device that has a power-on or activity LED. As power is restored to the USB and the system wakes from sleep, the LED lights up.
Note: An Apple USB-C to USB adapter may be used if power does not need to be supplied to the computer.
- Resetting the SMC instantly shuts down the computer, with some side effects:
 - If the computer is in sleep mode, it will reboot from a hibernation file.
 - If the computer is running OS X or macOS during the SMC reset, data from open applications can be lost.
 - If the computer is already shut down, there will be no side effects.

Diagnostic Software

Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). With AST 2, technicians initiate diagnostics wirelessly on a user's device using a Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results on the Diagnostic Console.

For more information, refer to:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)

Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built-in to all Mac computers released in June 2013 and later.

For more information, refer to:

- [HT202731: How to use Apple Diagnostics on your Mac](#)
- [HT203747: Apple Diagnostics: Reference codes](#)

Thermal and Electrical Sensors

Thermal and Electrical Sensors

Reference the tables below for sensor information:

- Thermal Sensor Table for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)
- Electrical Sensor Table for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

Thermal Sensor Table for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

SMC Name	Location	Diagnostic Name (Degrees C)	Troubleshooting Suggestion
TB0T	Battery	Battery Temp	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB1T	On BMU	Battery TS1	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB2T	Near battery cell	Battery TS2	Excessive battery temperature, open/damaged BMU or logic board contacts.
TBXT	Battery	Battery Temp (Same as TB0T)	Excessive battery temperature, open/damaged BMU or logic board contacts.
TC0F	Logic board, top side, mid	CPU PECI die temp filtered then adjusted	Excessive temperature on the logic board near the CPU.
TC0P	Logic board, top side, mid	CPU Proximity Temp	Excessive temperature on the logic board near the CPU.
TC1C	Logic board, top side, mid, inside large CPU IC	CPU Core 0 Temp (PECI)	Excessive CPU temperature or the CPU is malfunctioning.
TC2C	Logic board, top side, mid, inside large CPU IC	CPU Core 1 Temp (PECI)	Excessive CPU temperature or the CPU is malfunctioning.
TCGC	Logic board, top side, mid, inside large CPU IC	CPU Gfx Core Temp (PECI)	Excessive CPU temperature or the CPU is malfunctioning.
TCHP	Logic board, bottom side, mid, near battery connector	Charger Proximity Temp	Excessive temperature on the logic board near the battery connector.
TCSA	Logic board, top side, mid, inside large CPU IC	CPU System Agent Core Temp (PECI)	Excessive CPU temperature or the CPU is malfunctioning.
TCXC	Logic board, top side, mid, inside large CPU IC	CPU Core PECI Temp	Excessive CPU temperature or the CPU is malfunctioning.
TH0A	Logic board top side, left, inside large flash storage IC	SSD Temp A	Excessive flash storage temperature.
TH0B	Logic board top side, left, inside large flash storage IC	SSD Temp B	Excessive flash storage temperature.
TH0C	Logic board top side, left, inside large flash storage IC	SSD Temp C	Excessive flash storage temperature.
TH0F	Logic board top side, left, inside large flash storage IC	Drive 0 OOBv3 relative cooked temp Max Filtered	Excessive flash storage temperature.
TH0R	Logic board top side, left, inside large flash storage IC	Drive 0 OOBv3 relative cooked temp Max	Excessive flash storage temperature.
Th0N	Logic board top side, left, near large flash storage IC	NAND Temp	Excessive temperature on the logic board near the flash storage ICs.
Th0R	Audio board	Audio Board Temp	Excessive temperature on the audio board.
TM0P	Logic board top side, right	Memory Proximity Temp	Excessive temperature on the logic board near the memory ICs.
TPCD	Logic board bottom side, right	PCH Die Temp	Excessive temperature on the large PCH IC.
Ts0P	IPD board (trackpad)	Trackpad Temp	Excessive temperature on the IPD board or the trackpad is damaged/disconnected from the logic board.
Ts1P	Actuator (trackpad)	Trackpad Actuator Temp	Excessive temperature at the trackpad actuator or the trackpad is damaged/disconnected from the logic board.
TW0P	Logic board bottom side, mid	Wireless Proximity Temp	Excessive temperature on the logic board near the wireless IC.

Electrical Sensor Table for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

SMC Name	Location	General Description	Units	Troubleshooting Suggestion
I33C	Logic board	3.3V Regulator output current	Amperes	Out-of-range regulator current was found or open signal to SMC. Possible issue with the logic board.
I50C	Logic board	5V Regulator output current	Amperes	Out-of-range regulator current was found or open signal to SMC. Possible issue with the logic board.
IAPC	Logic board	WLAN (Airport) & Bluetooth current	Amperes	Out-of-range wireless current was found or open signal to SMC. Possible issue with the logic board.
IB0L	Logic board	Battery Discrete (Limited Range) current	Amperes	Out-of-range battery current was found or open signal to SMC. Possible issue with the battery or logic board.
IBAC	Logic board	Battery current	Amperes	Out-of-range battery current was found or open signal to SMC. Possible issue with the battery or logic board.
IBLR	Logic board	LCD backlight current	Amperes	Out-of-range LCD backlight current was found or open signal to SMC. Possible issue with the display or logic board.
IC0R	Logic board	CPU computing high side current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
ICAM	Logic board	CPU Core (IMON) current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
ICGM	Logic board	CPU GT+GTX (IMON) current	Amperes	Out-of-range CPU Gfx current was found or open signal to SMC. Possible issue with the logic board.
ICIC	Logic board	CPU VccIO current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
ICSC	Logic board	CPU VccSA current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
ICUC	Logic board	CPU 1.0V Suspend current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
ID0R	Logic board	DC in rail current	Amperes	Out-of-range DC-IN power current. Possible defective I/O board or flex cable, or open signal to SMC. Verify the correct power adapter, charge cable, and flex cable connections.
IHCC	Logic board	SSD Picollo 3.3V current	Amperes	Out-of-range flash storage current was found or open signal to SMC. Possible issue with the logic board.
IHNC	Logic board	SSD NAND current	Amperes	Out-of-range flash storage current was found or open signal to SMC. Possible issue with the logic board.
ILDC	Logic board	LCD Panel current	Amperes	Out-of-range LCD display current was found or open signal to SMC. Possible issue with the display or logic board.
IM0C	Logic board	Memory & CPU 1.2V current	Amperes	Out-of-range memory current was found or open signal to SMC. Possible issue with the logic board.
IM1C	Logic board	LPDDR 1.2V current	Amperes	Out-of-range memory current was found or open signal to SMC. Possible issue with the logic board.
IO0R	Logic board	Other Highside current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
IPBR	Logic board	PBus on battery current	Amperes	Out-of-range current from battery or charge circuitry found on the logic board, or open signal to SMC. Use the correct power adapter and verify that the USB-C charging cable connector pins are clean and make a good electrical connection. Disconnect and reconnect the battery to reseal the logic board connection. Recharge the battery.
ISCC	Logic board	Southbridge VCC PrimeCore current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
VC0C	Logic board	CPU Core Voltage	Volts	Out-of-range CPU voltage was found or open signal to SMC. Possible issue with the logic board.
VCGC	Logic board	CPU Vcc GT / GTX Voltage	Volts	Out-of-range CPU Gfx voltage was found or open signal to SMC. Possible issue with the logic board.
VD0R	Logic board	DC-in voltage	Volts	Out-of-range DC-IN voltage. Possible defective power adapter. Verify the correct power adapter, charge cable, and I/O flex cable connections.
VP0R	Logic board	PBus rail Voltage	Volts	Out-of-range voltage from battery or charge circuitry found on the logic board, or open signal to SMC. Use the correct power adapter and verify that the USB-C charging cable connector pins are clean and make a good electrical connection. Disconnect and reconnect the battery to reseal the logic board connection. Recharge the battery.

Temperature Concerns

The normal operating temperature of this computer is well within national and international safety standards. Nevertheless, users may be concerned about generated heat. To prevent an unnecessary repair, compare a user's computer to a similar running model under similar load, if available at the repair site.

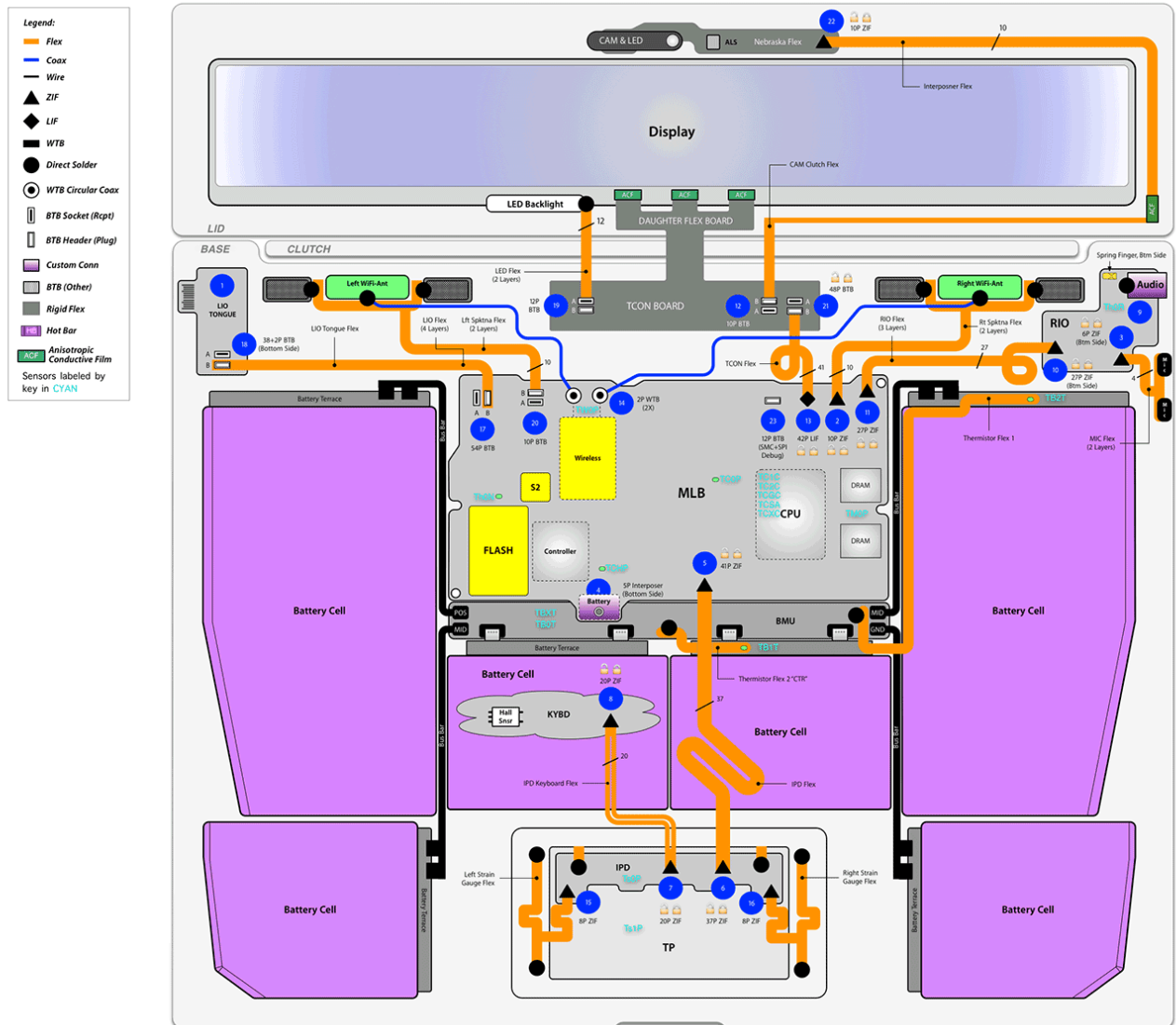
For more information, refer to articles

- [HT201640: Mac notebooks: Operating temperature](#)
- [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#)
- [HT202179: About fans and fan noise in your Mac](#)

Interconnect Diagram

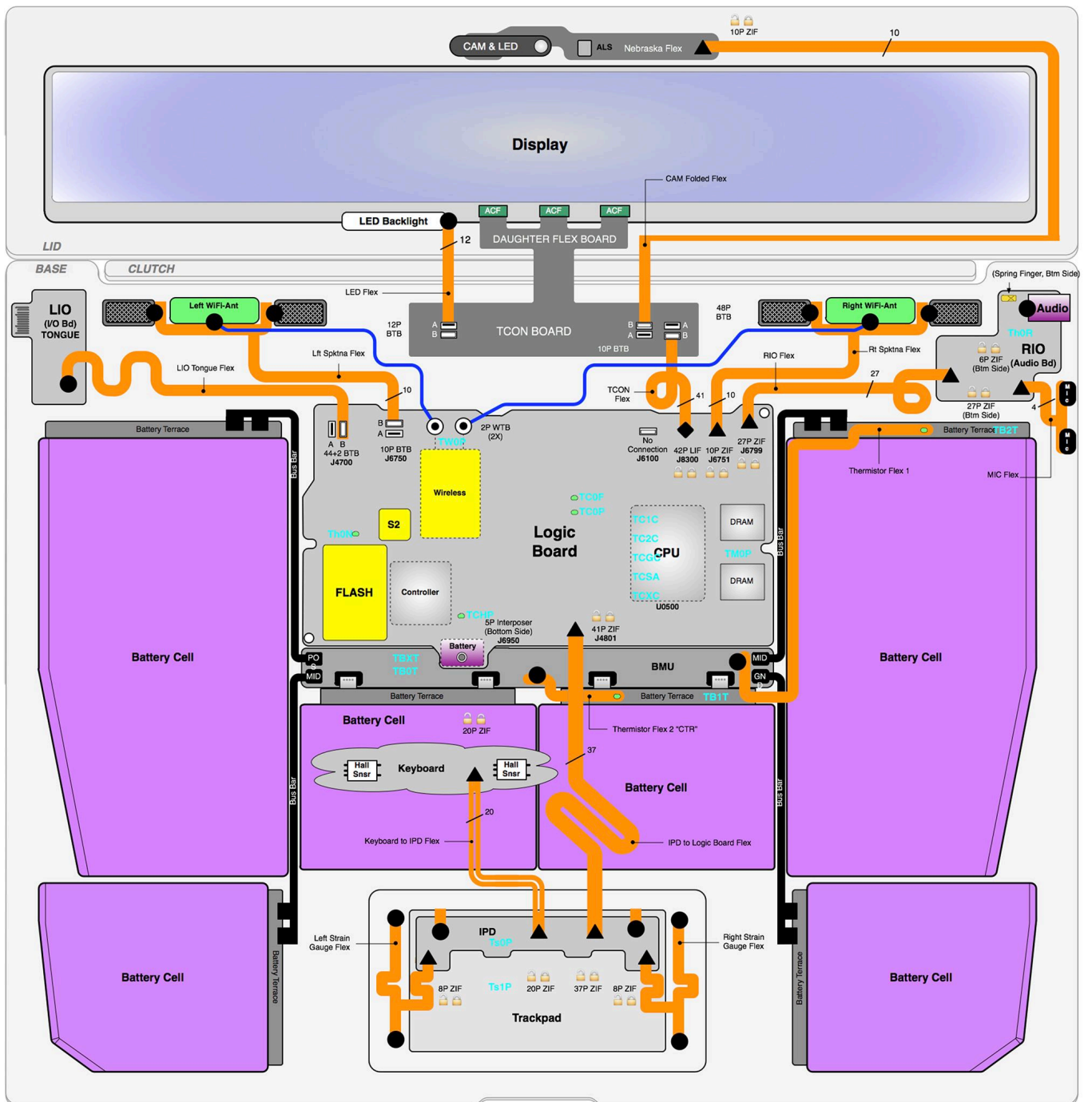
Interconnect Diagram for MacBook (Retina, 12-inch, Early 2015)

Refer to this diagram to see how modules are interconnected. Click or tap on the image to see a larger version.



Interconnect Diagram for MacBook (Retina, 12-inch, Early 2016 and 2017)

Refer to this diagram to see how modules are interconnected. Click or tap on the image to see a larger version.



Block Diagram

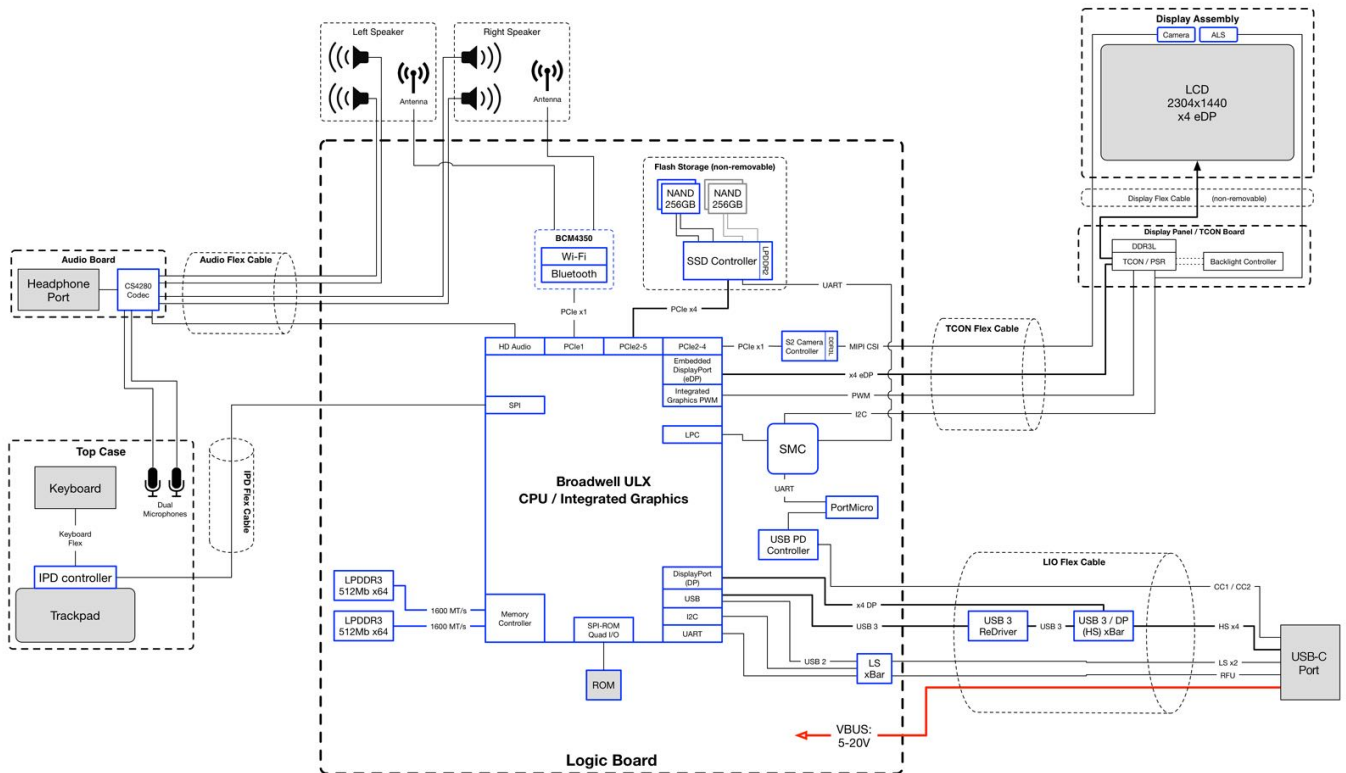
Block Diagrams

This article contains the following sections:

- [Block Diagram for MacBook \(Retina, 12-inch, Early 2015\)](#)
- [Block Diagram for MacBook \(Retina, 12-inch, Early 2016\)](#)
- [Block Diagram for MacBook \(Retina, 12-inch, 2017\)](#)

Block Diagram for MacBook (Retina, 12-inch, Early 2015)

Refer to this diagram to see how modules are interrelated. Click or tap on the image to see a larger version.

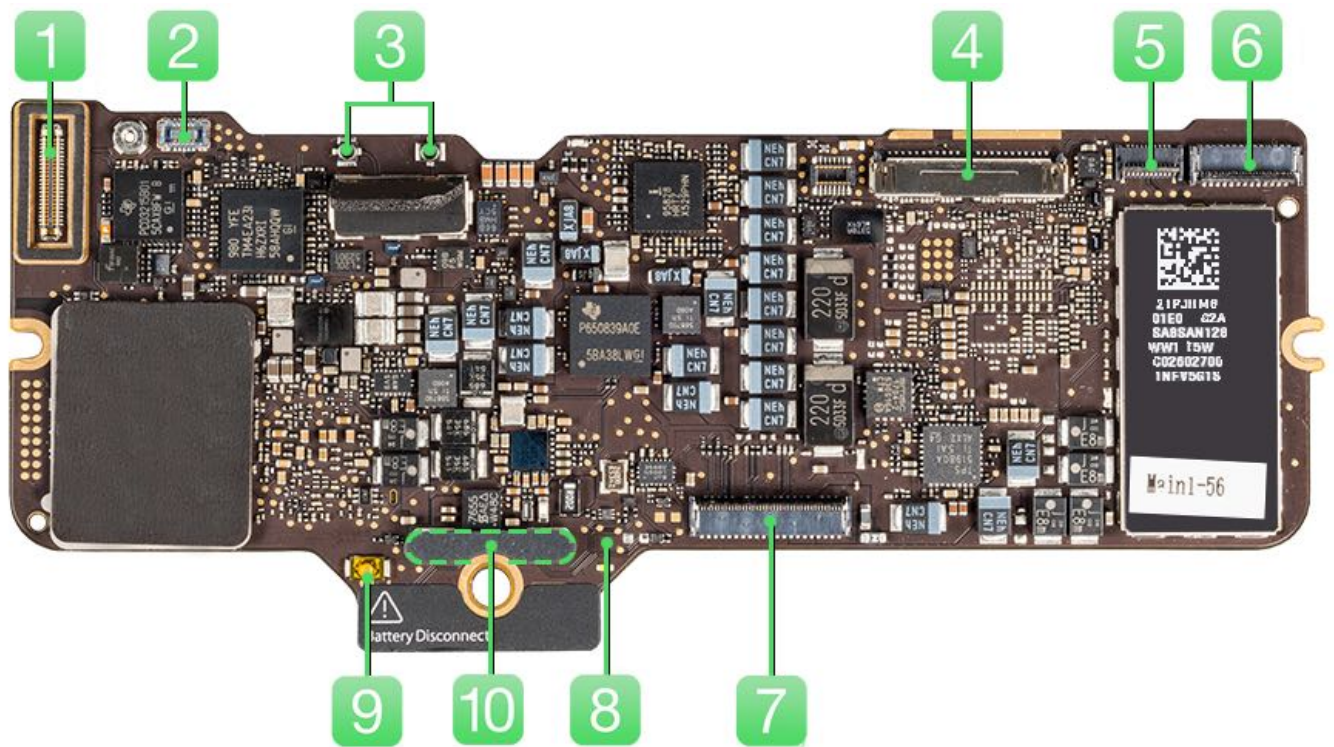


Block Diagram for MacBook (Retina, 12-inch, Early 2016)

Refer to this diagram to see how modules are interrelated. Click or tap on the image to see a larger version.

Functional Overview

Functional Overview for MacBook (Retina, 12-inch, Early 2016 and 2017)



1 = I/O board and flex cable

- No power
- Power adapter issues
- USB connectivity issues
- No video to external display
- No audio to external display speakers

2 = Left speaker

- No or distorted audio from left internal speakers

3 = Wireless antenna connectors

- Wi-Fi issues
- Bluetooth issues

4 = Timing controller (TCON) board, flex cable, and display

- Power but blank/no video
- Backlight issues
- FaceTime camera issues

5 = Right speaker

- No or distorted audio from right internal speakers

6 = Audio board and flex cable

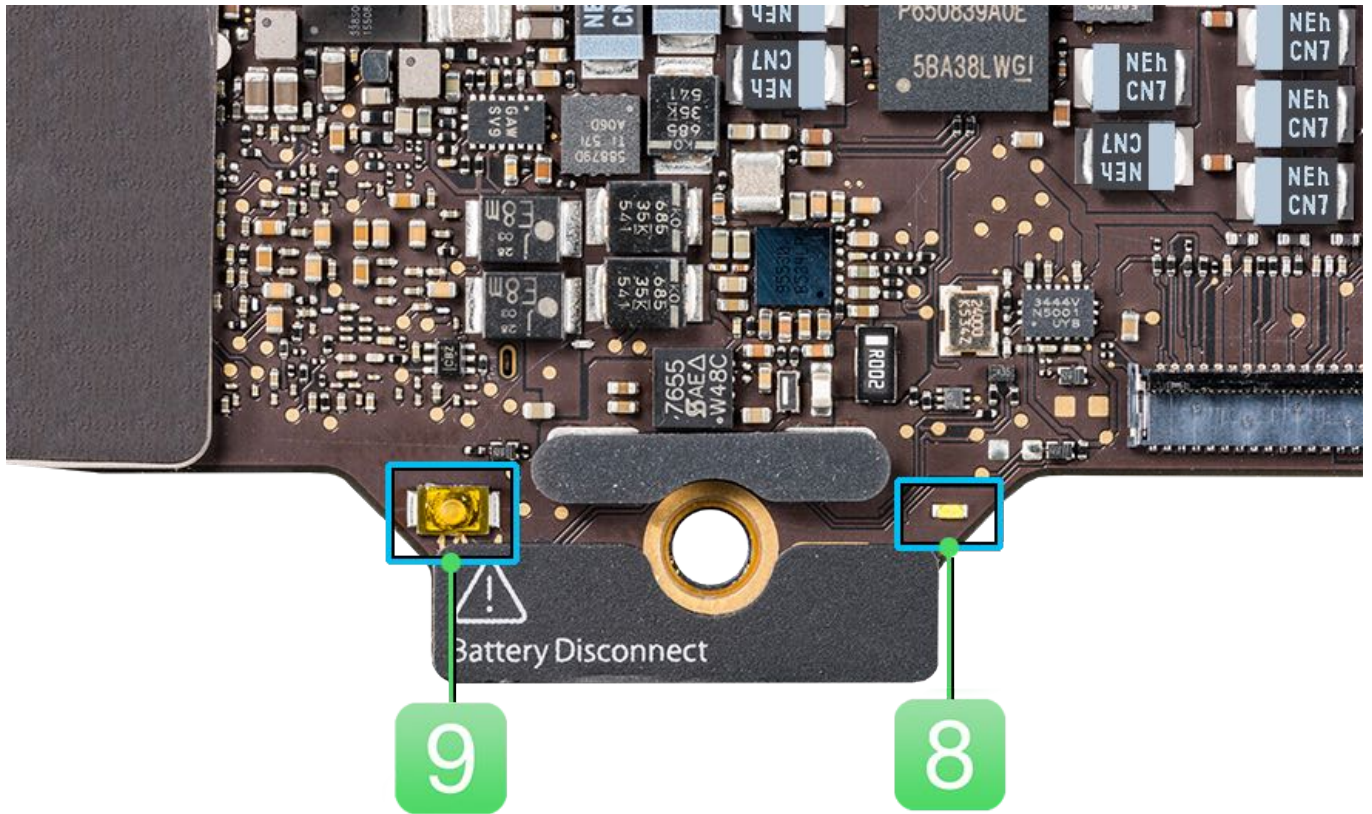
- No audio from internal speakers or headphone jack
- Internal microphone issues

7 = Input Device (IPD) to Logic Board flex cable (top case)

- Built-in trackpad issues
- Keyboard backlight issues
- Built-in keyboard does not work properly



Caution: You must use the battery disconnect button to turn off the power, and verify that the power LED is out, before proceeding with any repair. Failure to do so will result in damage to the logic board, the top case with keyboard, and the flex cables. Refer to article [RP1212: Bottom Case with Battery](#) for instructions.



8 = Power LED

- This is a dim white LED which indicates that power is connected and running through the logic board.
- **Caution:** Do not disconnect any cables or perform any repairs until this LED is off.

9 = Battery disconnect button

- This button is used to disconnect the battery and drain power from the logic board.
- Disconnect the battery by holding down this button until the power LED turns off. Do this immediately after opening the bottom case and before disconnecting any cables or performing any repairs.

10 = Battery connector (on underside of logic board)

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Extended time before boot chime with battery removed

Minimum Configuration

Minimum Configuration for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

Putting the computer in a minimum configuration helps determine which part may be malfunctioning by reintroducing parts one at a time until the problem recurs. This procedure is useful when troubleshooting symptoms such as:

- No power
- Will not start up
- Kernel panic

To troubleshoot the MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017) using the minimum configuration, remove or disconnect all parts except:

- Logic board
- I/O board and flex cable assembly
- Audio board
- Audio board flex cable
- Speaker/antenna module (Early 2015 and 2016 only)
- Power
 - 5W power adapter (Do not use a higher wattage for minimum configuration.)
 - USB-C cable

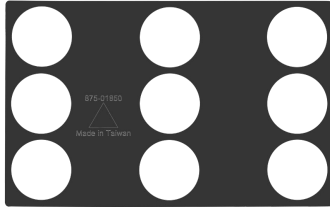
Reinstall or reconnect remaining parts one at a time until the issue is replicated.

Trackpad Calibration Check

For video instruction, refer to article [SV279: Force Touch Trackpad Calibration Check Video](#).

Required tools:

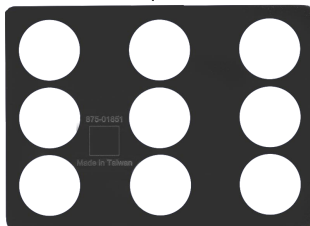
- Weight Placement Rubber Template (923-00555)
 - MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)



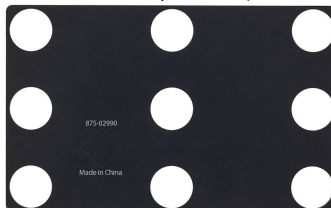
- Weight Placement Rubber Template (923-01316)
 - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
 - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)



- Weight Placement Rubber Template (923-00599)
 - MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)



- Weight Placement Rubber Template (923-01317)
 - MacBook Pro (15-inch, 2016 and 2017)



Note: Weight Placement Rubber Templates come in a pack of three. If the edges start to curl, it is necessary to order a new pack.

- 200g and 800g weights (923-00462)



Steps:

To verify that the trackpad is responding as expected, the technician must run the Trackpad Calibration Check after every repair or whenever the computer has been reassembled.

Note: It is recommended to also run the Trackpad Response test after a top case with keyboard has been replaced, or if the user is having issues related to trackpad functionality.

1. Place the Weight Placement Rubber Template on the trackpad before launching the test in AST 2. This establishes the correct baseline for the weights.

Important: The Weight Placement Rubber Template does not need to be taped to the top case. Tape may cause inaccurate test results.



2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to article [TP1279: AST 2: Supported Products and Tests](#).

Caution: The Trackpad Calibration Check is very sensitive to external disturbances. The test should be run on a flat surface. Do not run the diagnostic on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the diagnostic. If the computer is bumped or jostled while the diagnostic is running, the technician will have to begin the test again.

[< Diagnostic Results](#)

Diagnostic Suites

TRIAGE



Trackpad Response

Assists in verifying functionality of trackpad.



3 minutes



REPAIR



Trackpad Calibration Check

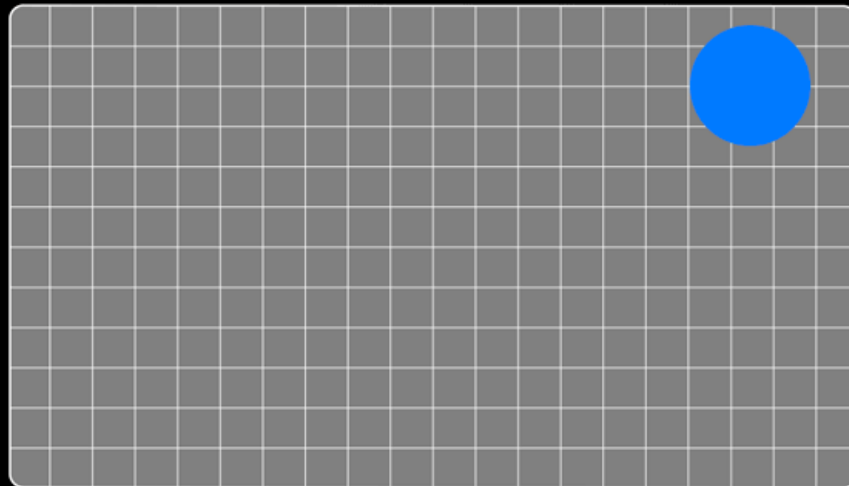
Verifies calibration of the trackpad actuator and force sensor.



3 minutes

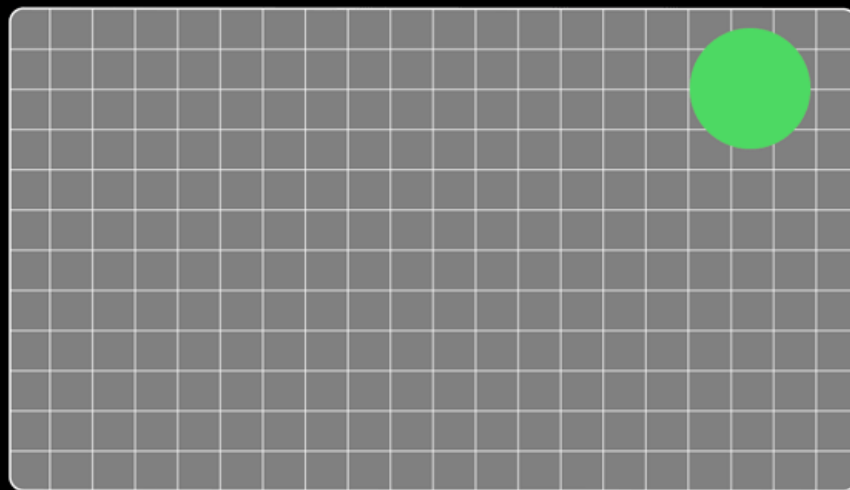


3. The diagnostic suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires the technician to place the 200g and 800g weights as indicated. The blue dot will indicate where to place each weight on the trackpad. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.



Test Instruction

Place the 200g weight on the indicated area and press any key.

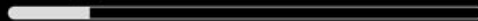


Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the test may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...



Restart



Shut Down

5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



About Device



Input Device

- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ✓ Force Check

6. If issues were found in the Actuator Check, the Actuator Calibration, or the Force Check, the screen will look like the image below and the suite should be run again. If the computer fails a second time, a top case with keyboard replacement is recommended.



MacBook Pro

C0282-001-0000-0000

Issues Found

Trackpad Calibration Check

October 20th, 2016 2:19 PM



About Device



Input Device

- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ! Force Check

Connector Types on the Logic Board

Connector Types on the Logic Board for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

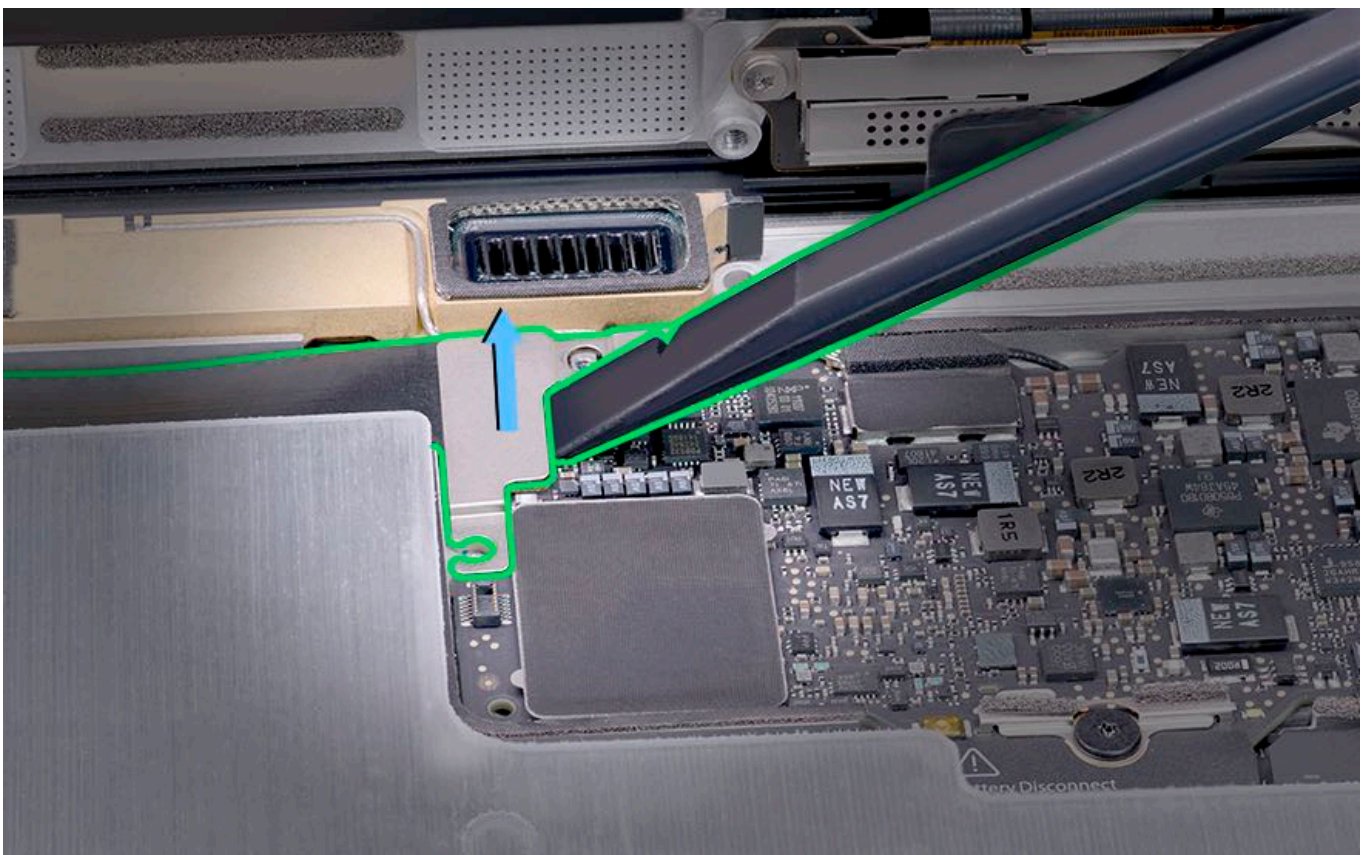
This article discusses how to disconnect and connect the various types of connectors in this model of computer and provides examples of each connector type.

Caution: Do not disconnect or reconnect cables while the computer has power.

Low-Profile Solid Platform Flex

- Remove and insert the cable vertically. The pins on the connectors can be bent if they are not inserted carefully and correctly.
- To reconnect the cable, keep the connector level to the board and press down evenly.
 - Left speaker cable
 - I/O board cable

For video instruction, refer to article [SV89: Solid Platform Flex Connectors Video](#).



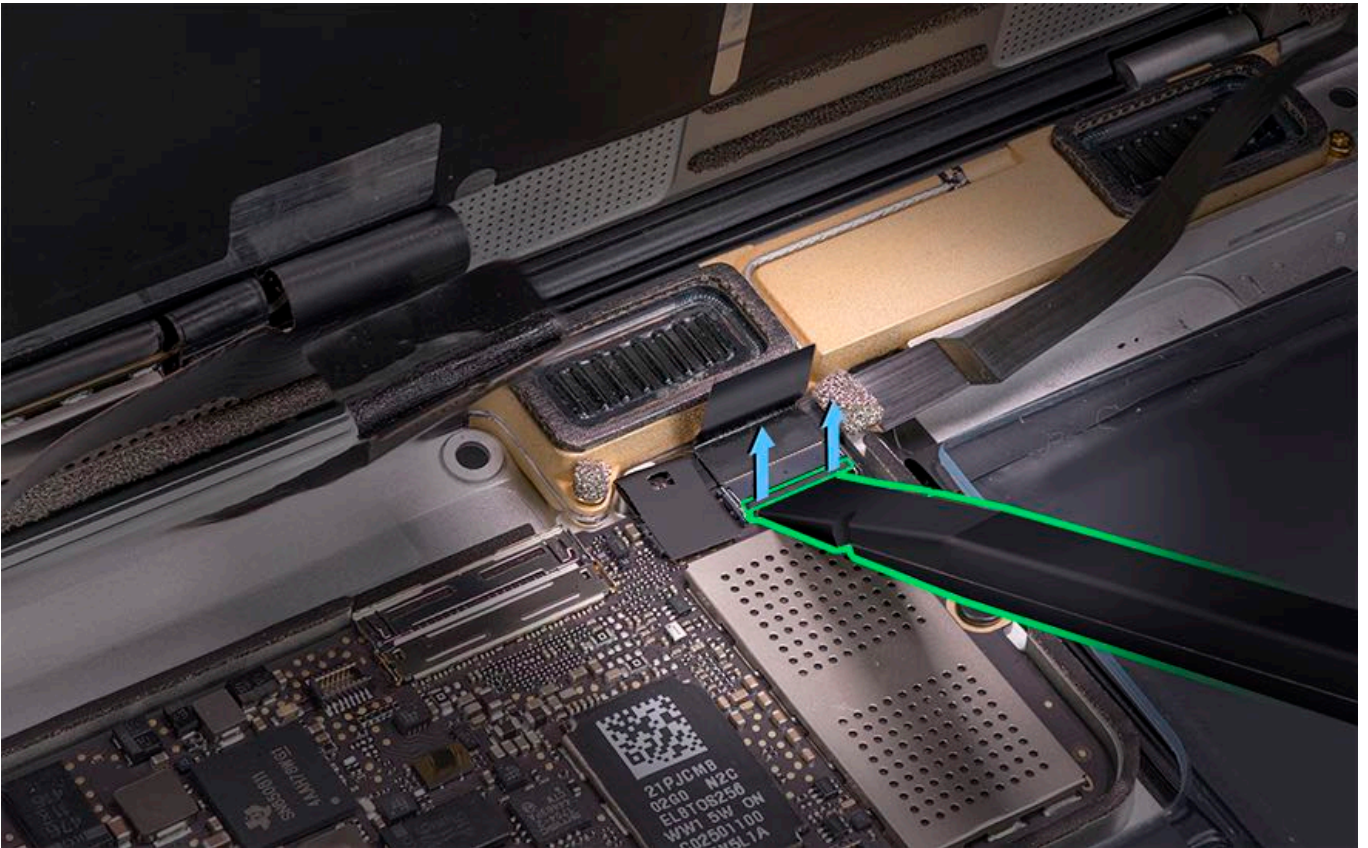
Locking Lever

Example:

- Flip the lever up to a 90-degree angle for cable removal.
- Slide the cable into the receptacle on the same horizontal plane as the logic board.
- Lock down the lever after inserting the cable.
- Open the lever when handling or shipping a logic board module, whether it is a known-good or a known-bad board.
 - Right speaker cable
 - Audio board flex cable
 - Input device (IPD) flex cable



Caution: The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, always leave the levers open after the cables are removed. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.



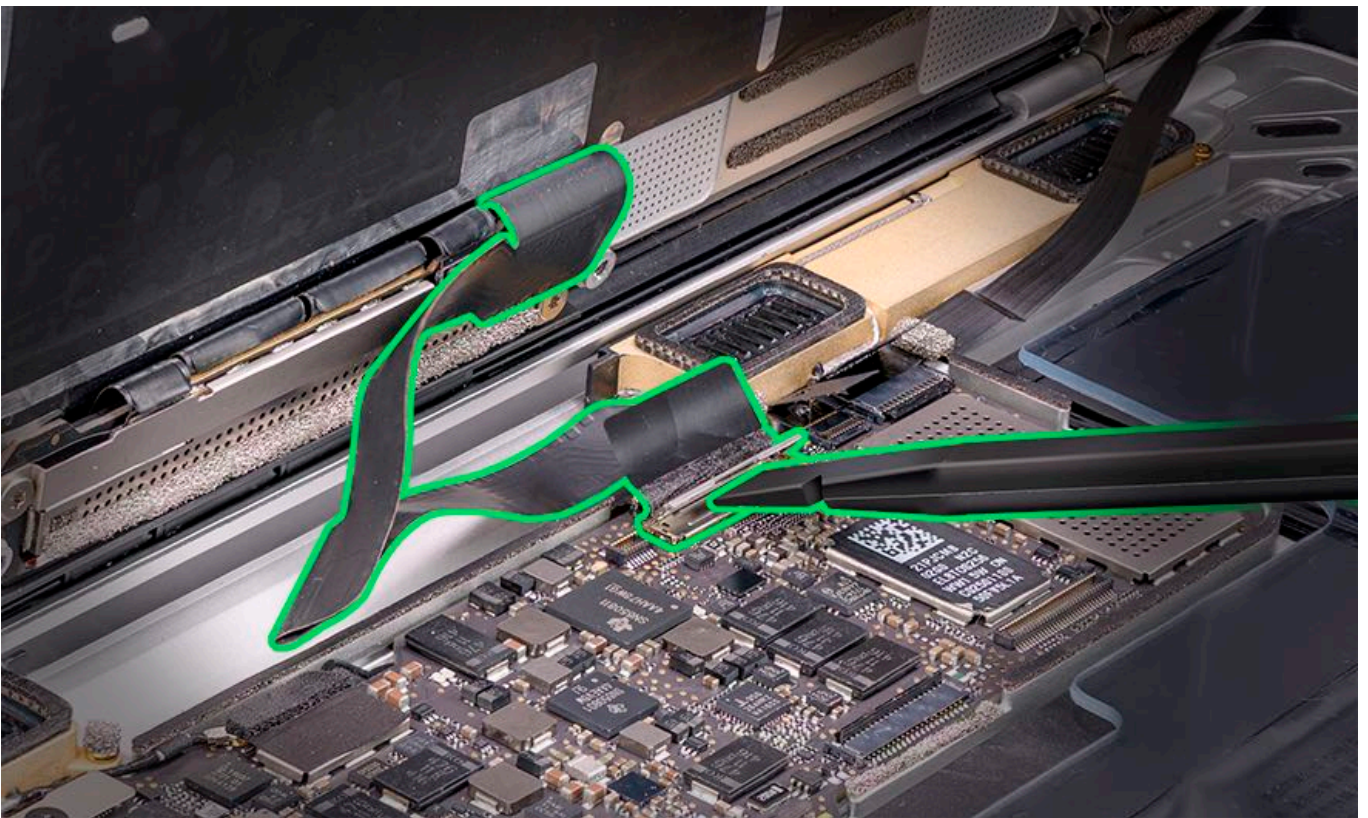
Thin, Multi-Pin Horizontal Insert: Locking Bar



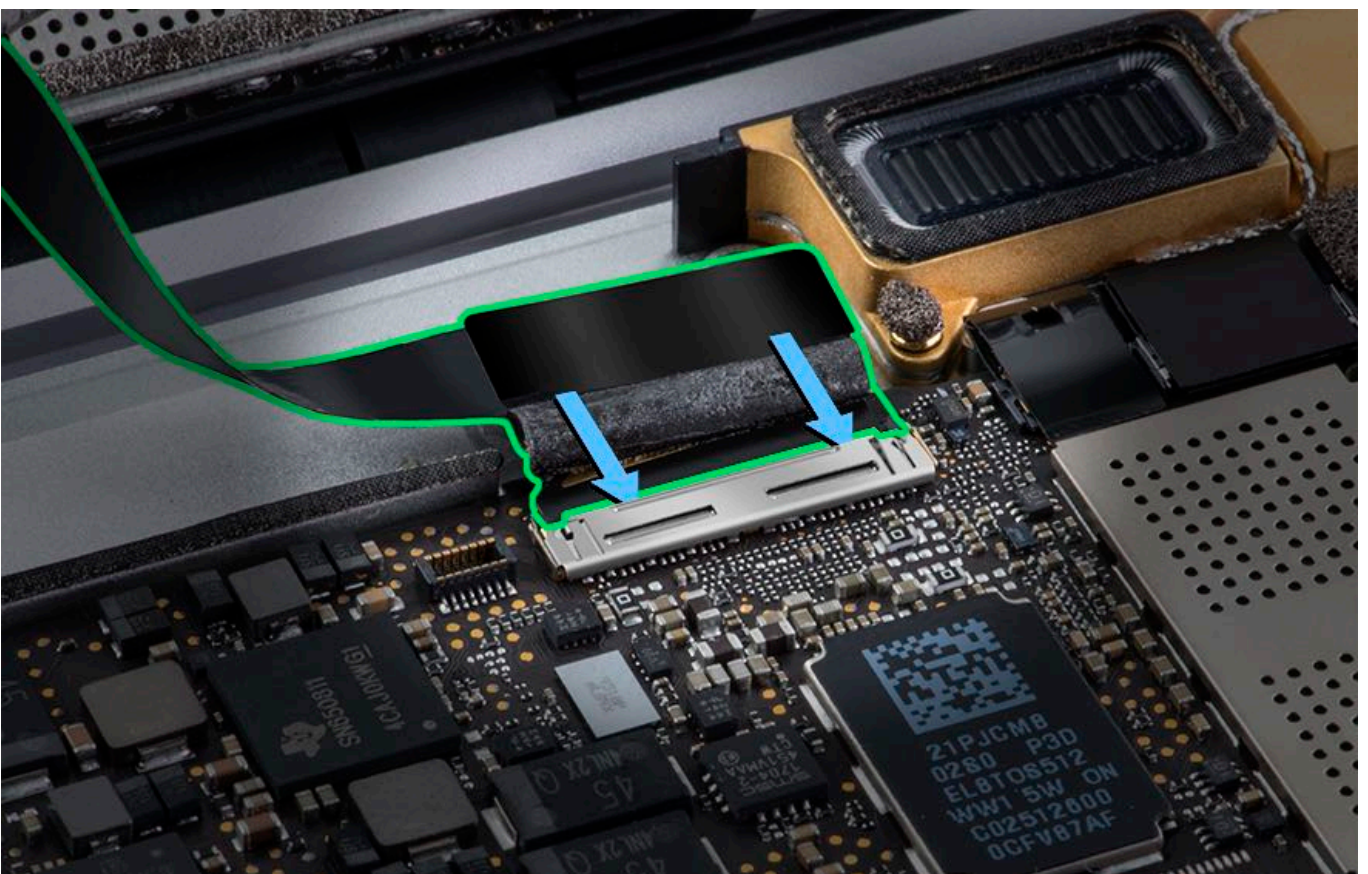
Caution: For MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017), the lock bar on the TCON flex cable connector must be **closed** before reinserting the cable. For instruction, refer to article [RP1212: Bottom Case with Battery](#).

Example:

- Flip the lock bar up before disconnecting the cable, but do not use the bar as a handle when disconnecting.
 - TCON flex cable



- To avoid damage to the logic board connector, the locking lever for the TCON connector must be **closed** before reinserting the TCON board flex cable. If the connector is damaged, the logic board must be replaced.



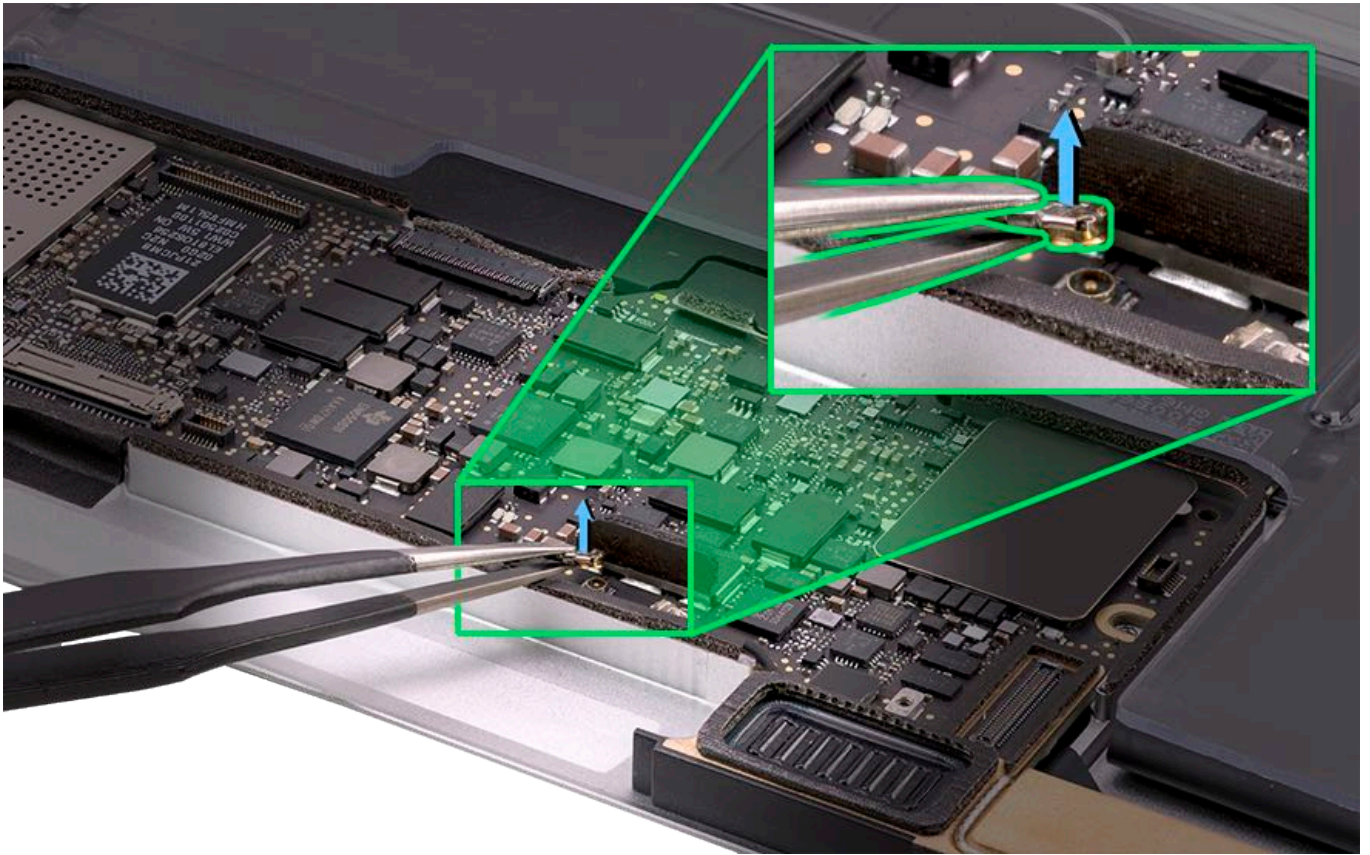
Wireless Antenna Connectors

Example:

- The gold connectors are fragile, so handle them with care.
- To disconnect, grasp behind the connector head with ESD-safe tweezers.
- Lift straight up from the receptacle.

- Wireless antenna cables

For video instruction, refer to article [SV91: Wireless Antenna Connectors Video](#).



Tools and Fixtures

Tools and Fixtures for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

Caution: To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

The following tools are required:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from the unit)
- Pentalobe screwdriver
- #0 Phillips screwdriver
- #000 Phillips screwdriver
- #00 trilobe screwdriver (922-9013)
- Torx T3 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Black stick (nylon probe, 922-5065) or other nonconductive nylon or plastic flat-blade tool
- ESD-safe tweezers for wireless cables
- Antenna tool (923-01322)
- Painter's tape (tape that does not leave a residue, 1 to 2 inches wide, preferably 2-inch if available)
- Ultraviolet Flashlight (923-01604) for MacBook (Retina, 12-inch, 2017)

Electrostatic Discharge (ESD) Precautions

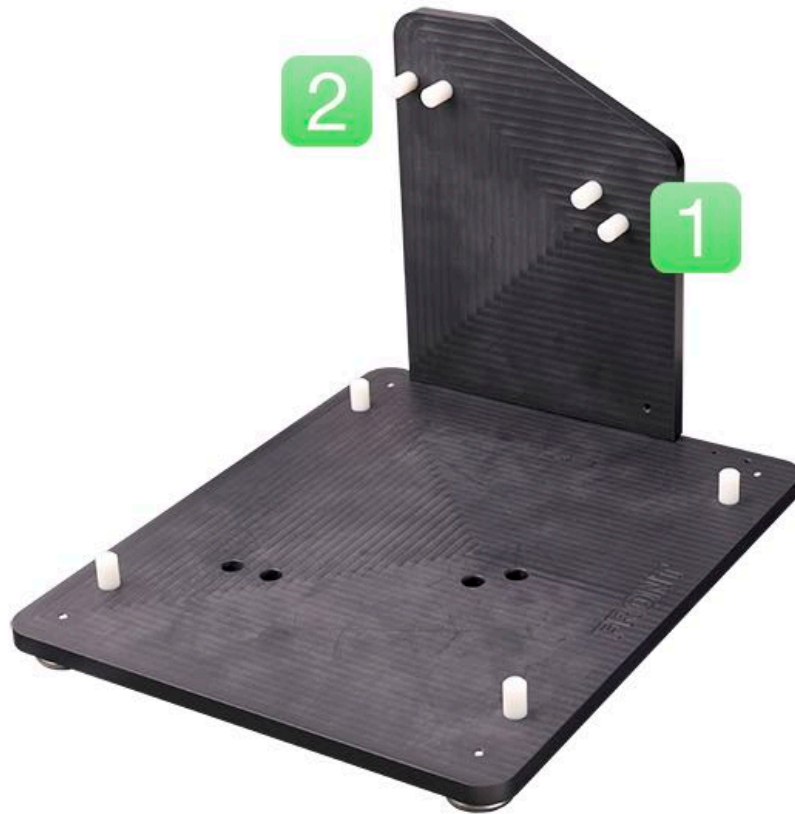
Proper ESD precautions must always be used when servicing this product. Make sure you are working on a properly grounded ESD-safe mat and are wearing a properly connected ESD-safe wrist strap.

For more information about ESD, refer to:

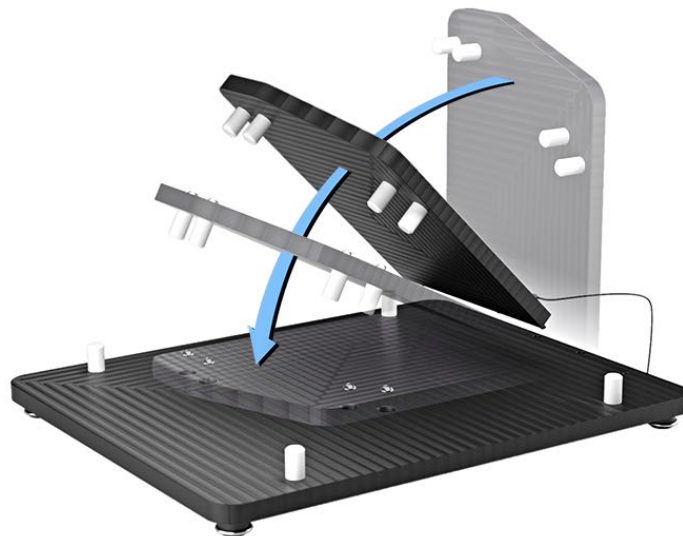
- [OP100: Electrostatic Discharge Precautions and Myths](#)
- [ATLAS: ESD Precautions](#)

Fixtures

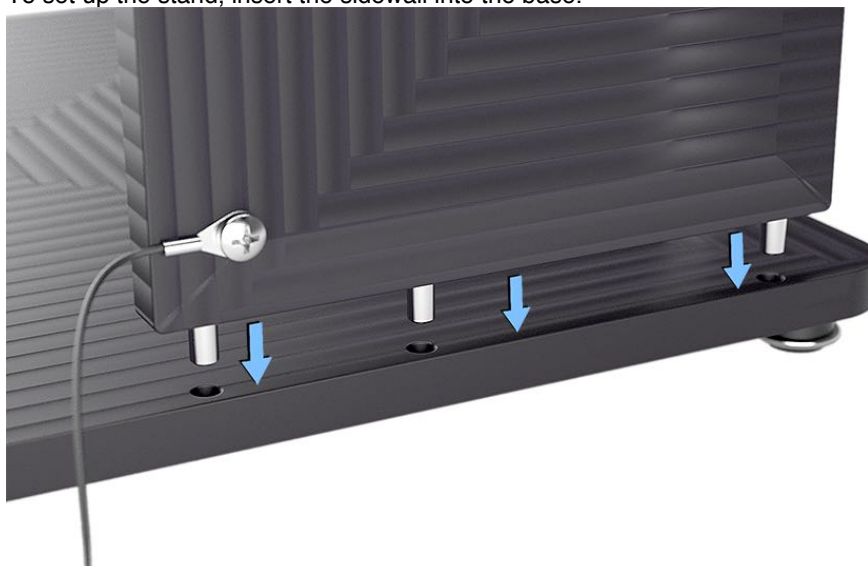
- MacBook Retina service stand (076-00068)
Note: The actual service stand may have slight cosmetic differences.
 - The service stand has two sets of pegs on the sidewall. In the Service Guide these are referred to as the first level (1) and the second level (2).



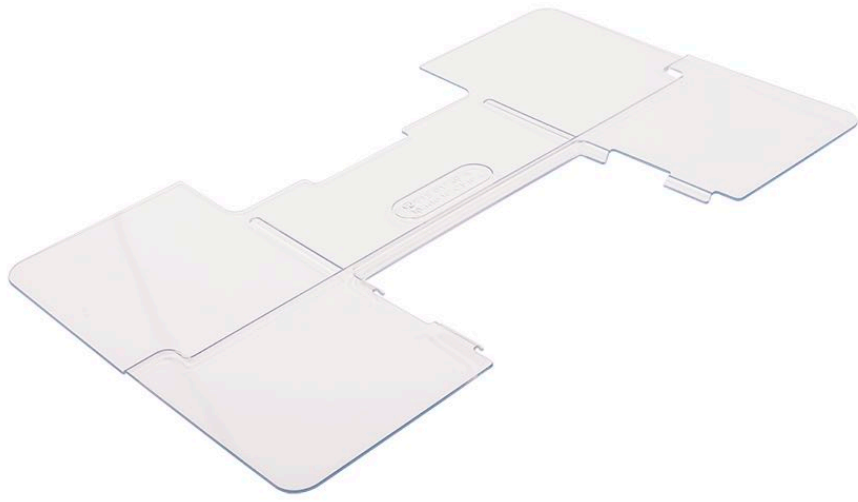
- The service stand stores and ships flat.



- To set up the stand, insert the sidewall into the base.



- Protective battery cover (076-00067)



- Trackpad calibration weights, 200g and 800g (923-00462)

Note: Do not store weights above the repair bench. Use the foam packaging in which the weights are shipped for storage in tool drawers.



Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



Bottom Case with Battery

First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

For video instruction, refer to article [SV275: Bottom Case with Battery Replacement Video](#).

- Disable the auto boot features. Refer to article [TP1484: Auto Boot](#).
- Shut down the computer.
- Unplug all cables.
- Place the computer face down on a clean, flat surface.



Caution: Read article [TP772: Battery Safety Setup](#) before performing this procedure. Follow ESD guidelines. Refer to article [OP100: Electrostatic Discharge Precautions and Myths](#).

Note: MacBook (Retina, 12-inch, Early 2015) may differ slightly in interior appearance from MacBook (Retina, 12-inch, Early 2016 and 2017). However, the repair procedures are the same unless noted in the service guide. Refer to article [TP1306: Internal Views](#).



Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Pentalobe screwdriver
- Black stick
- MacBook Retina service stand (076-00068)
- Protective battery cover (076-00067)

- Painter's tape (tape that does not leave a residue, 1 to 2 inches wide, preferably 2-inch if available)
- Trilobe #00 screwdriver (magnetized) (Early 2015 only)
- Phillips #000 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- ESD-safe tweezers
- Isopropyl alcohol (IPA) wipes
- Fine-tip permanent marker



Steps For Removal

1. Remove eight screws from the bottom case in the order indicated. Screws must be removed and installed at an angle.

- Pentalobe: (2.95 mm) (position 1, 2, 3, 4)
 - 923-00416 - silver
 - 923-00432 - space gray
 - 923-00406 - gold
 - 923-01040 - rose gold

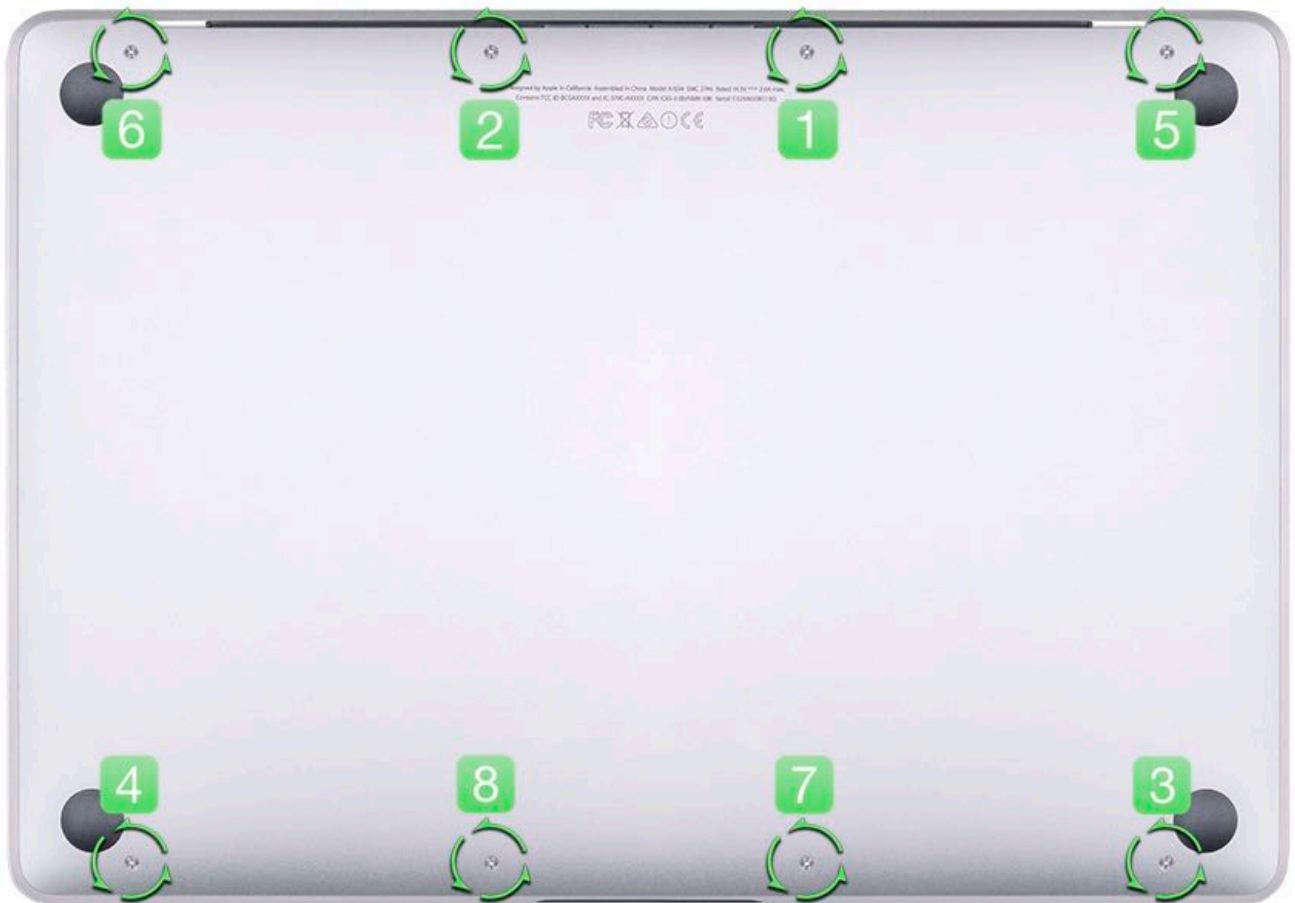


- Pentalobe: (6.23 mm, shoulder) (position 5, 6)
 - 923-00414 - silver
 - 923-00430 - space gray
 - 923-00409 - gold
 - 923-01038 - rose gold



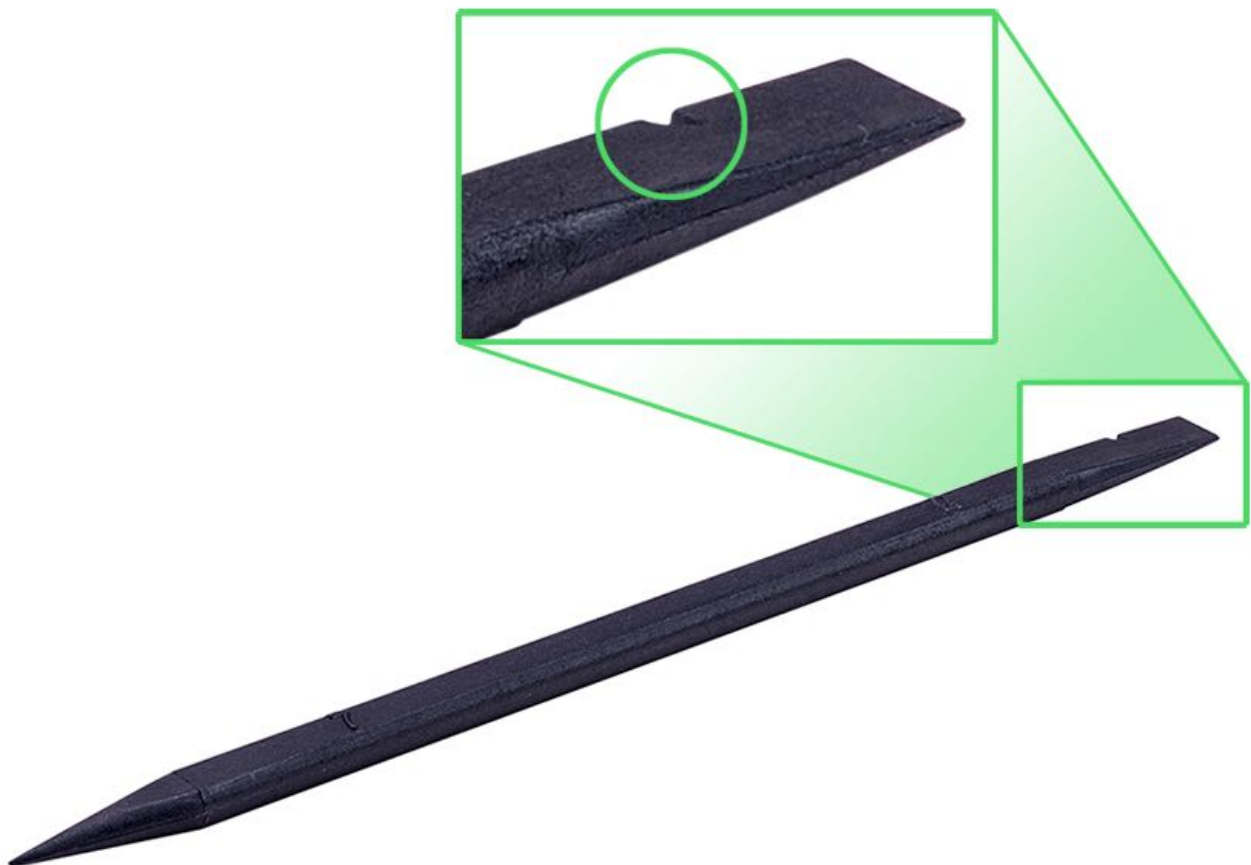
- Pentalobe: (1.78 mm) (position 7, 8)
 - 923-00415 - silver
 - 923-00431 - space gray
 - 923-00427 - gold
 - 923-01039 - rose gold





2. Insert the flat end of a black stick between the top and bottom case, starting at the rear of the computer.

Caution: The embedded battery is in the bottom case. Be extremely careful not to push the black stick in farther than the notch on the flat end.



3. Slide the black stick along the side of the case until you hear a “click” indicating the mushroom snaps have released.

Repeat on the other side.

Caution: To avoid damaging the flex cables, only loosen the bottom case. Do not remove it.



4. With the bottom case loosened but not removed, use two hands to turn over the computer so that the Apple logo is facing up.

5. Place the unit onto the base of the service stand.



6. Gently open the top case to the first level of the stand.

Caution: To avoid straining cables or damaging modules, do not raise the top case higher than the first level before the battery power is turned off or the cables are disconnected. This type of damage results in a costly repair.



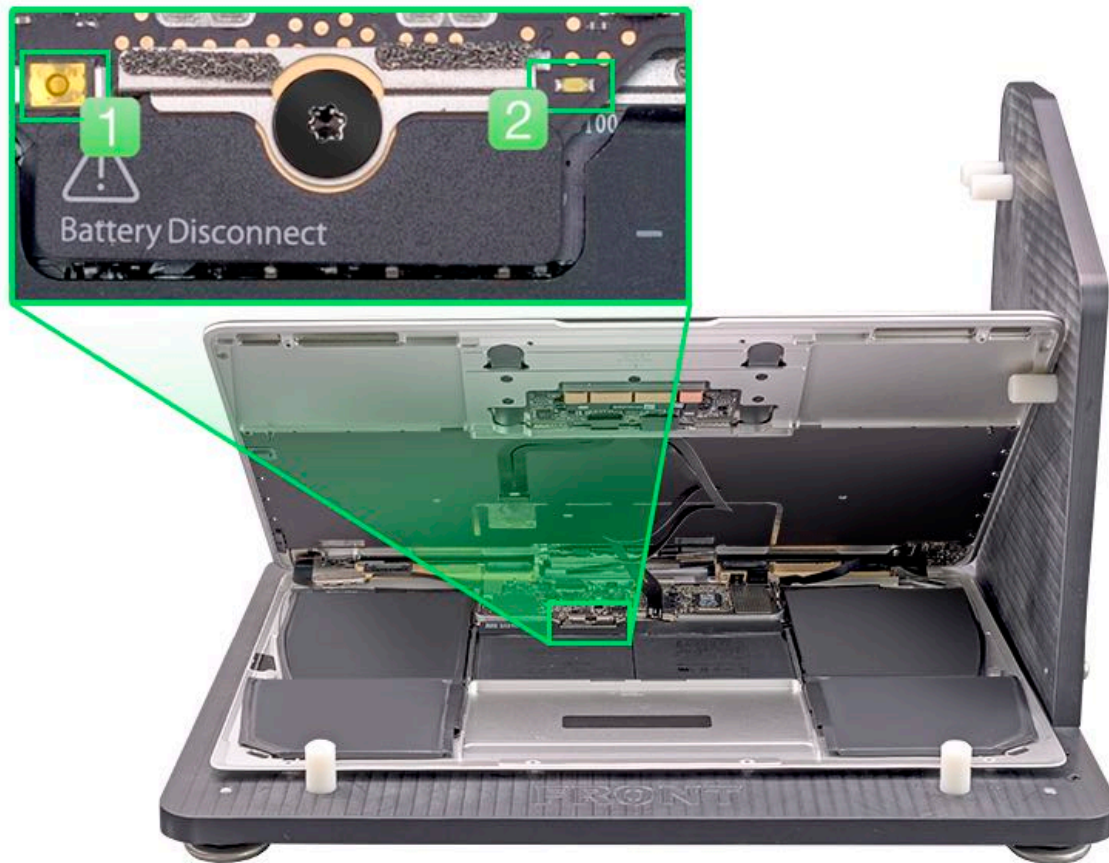
Caution: Do not proceed further until this step is complete.

Warning: Check that the computer is not connected to a power source.

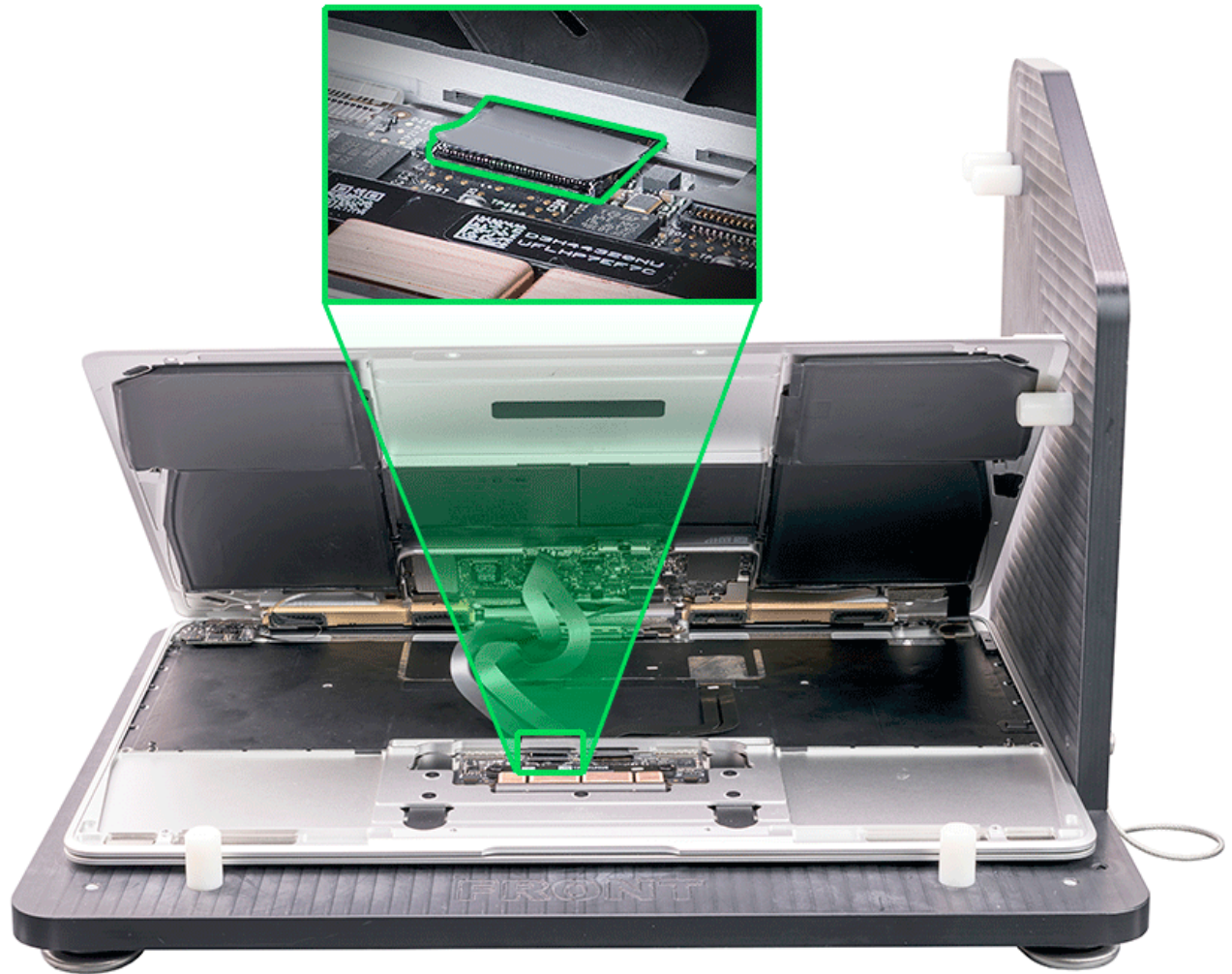
7. Use the flat end of a black stick to press the battery disconnect button (1), located on the logic board, to disengage the power from the battery.

Caution: Be careful not to touch the battery with the black stick.

- Press and hold the battery disconnect button (1) until the LED light (2) goes dark (about 5–10 seconds) to indicate that the power is off. **Caution:** If the LED (2) is not lit from the start, press the battery disconnect button (1) and hold for 5–10 seconds. Then repeat this action two more times to ensure the power is disconnected.
- Confirm that the LED light is out before proceeding any further. Failure to do so can result in damage to the trackpad (resulting in a top case replacement) or the logic board and flex cables.



8. Close the computer before removing it from the service stand.
9. Use both hands to turn the unit over so that the Apple logo is facing down.
10. Gently lift the bottom case to the first level of the service stand.
11. Use the flat end of a black stick to lift the locking lever from the input device (IPD) connector on the trackpad. Disconnect the IPD to logic board flex cable from the connector on the trackpad.



12. Close the computer and remove it from the service stand.

13. Use both hands to turn the unit over so the Apple logo is facing up.

14. Without straining the cables, gently open the top case so the display is at the second level of the service stand.

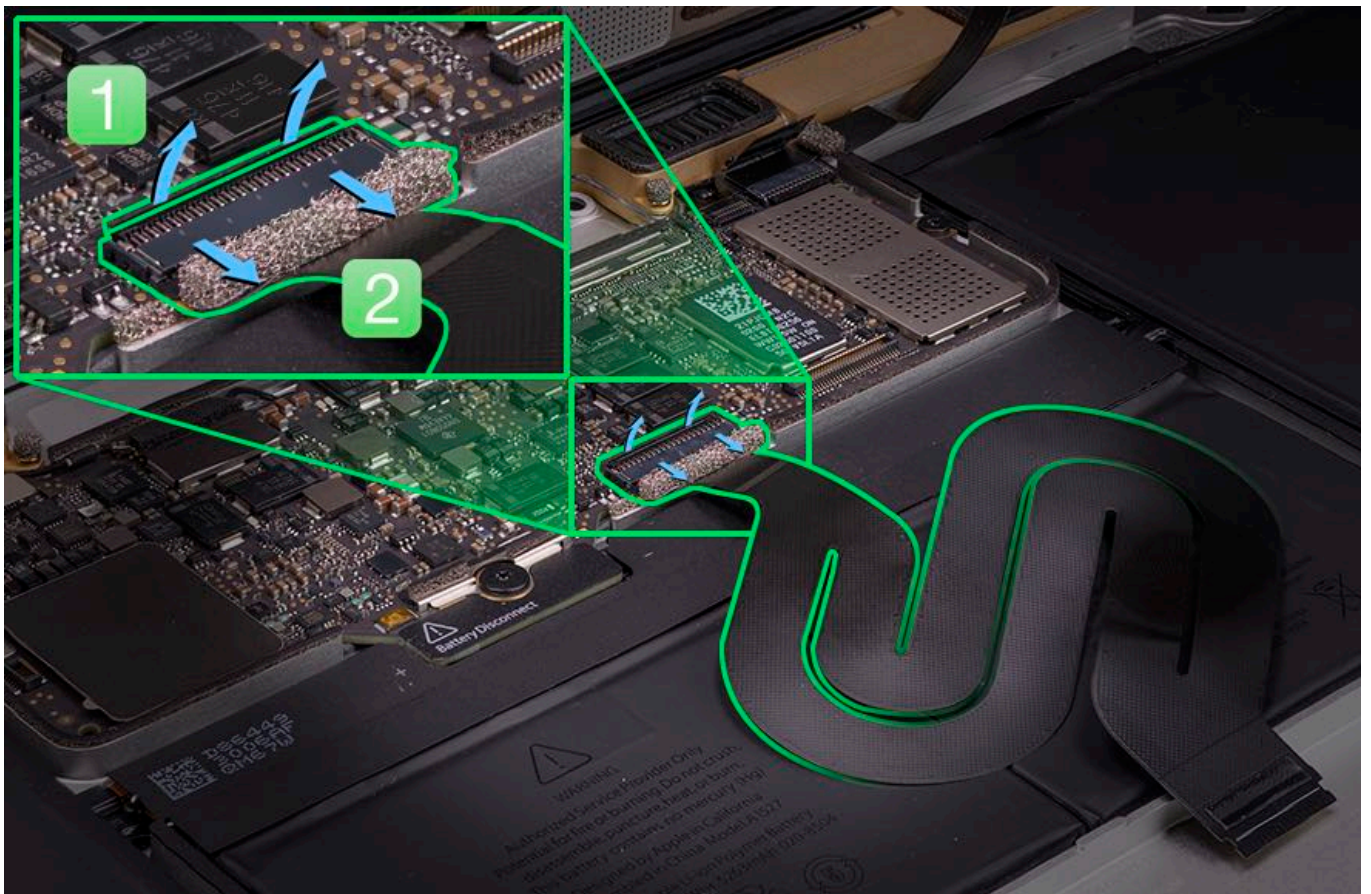
Caution: Do not set the top case on the speaker/antenna modules. This could cause damage to the speaker cones, resulting in a replacement of the speaker/antenna modules.



15. Use the flat end of a black stick to lift the locking lever from the IPD connector on the logic board (1).

16. Disconnect the IPD to logic board flex cable from the logic board. Lift the IPD to logic board flex cable out of the computer and set it aside (2).

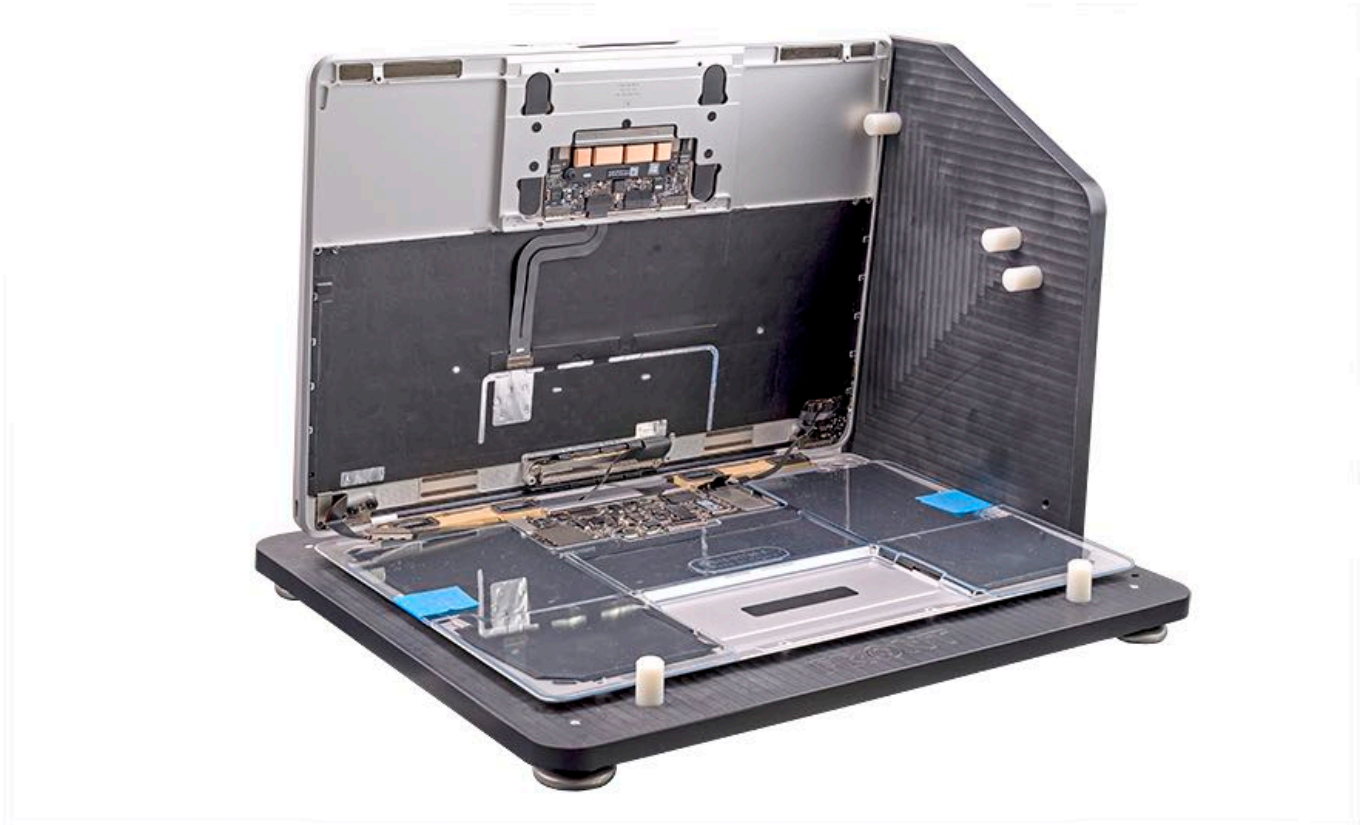
Note: The IPD to logic board flex cable is connected to the battery with VHB adhesive.



17. Place the protective battery cover over the battery and secure it to the bottom case using painter's tape on both sides.

Support the display and the bottom case while attaching the tape to the bottom case.

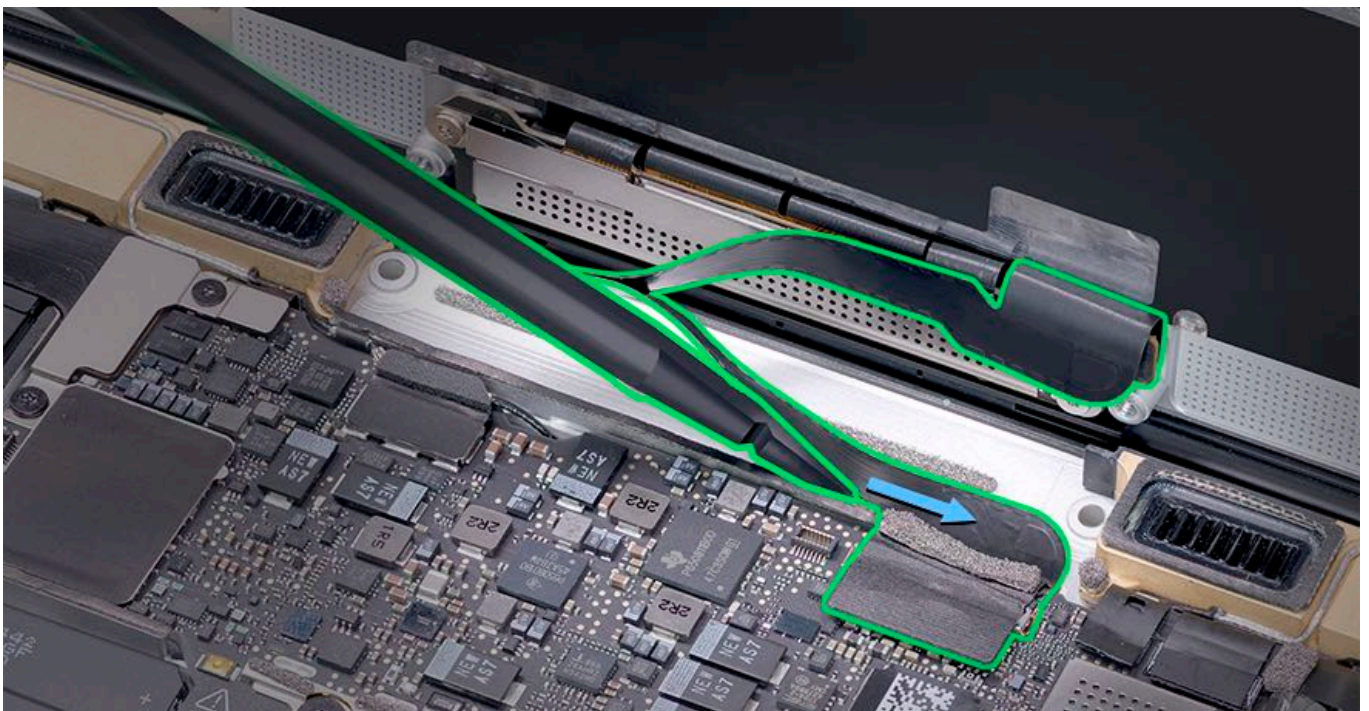
Caution: Support the display and the top case while attaching the tape to the bottom case to prevent it from falling over.



18. Use the flat end of a black stick to carefully loosen the timing controller (TCON) board flex cable from the adhesive on the bottom case.

Note:

- Be sure to loosen the adhesive all the way to where the flex cable connects on the logic board before attempting to disconnect the cable.
- If the adhesive is damaged, replace it with new adhesive included with bottom case and/or logic board replacement parts.



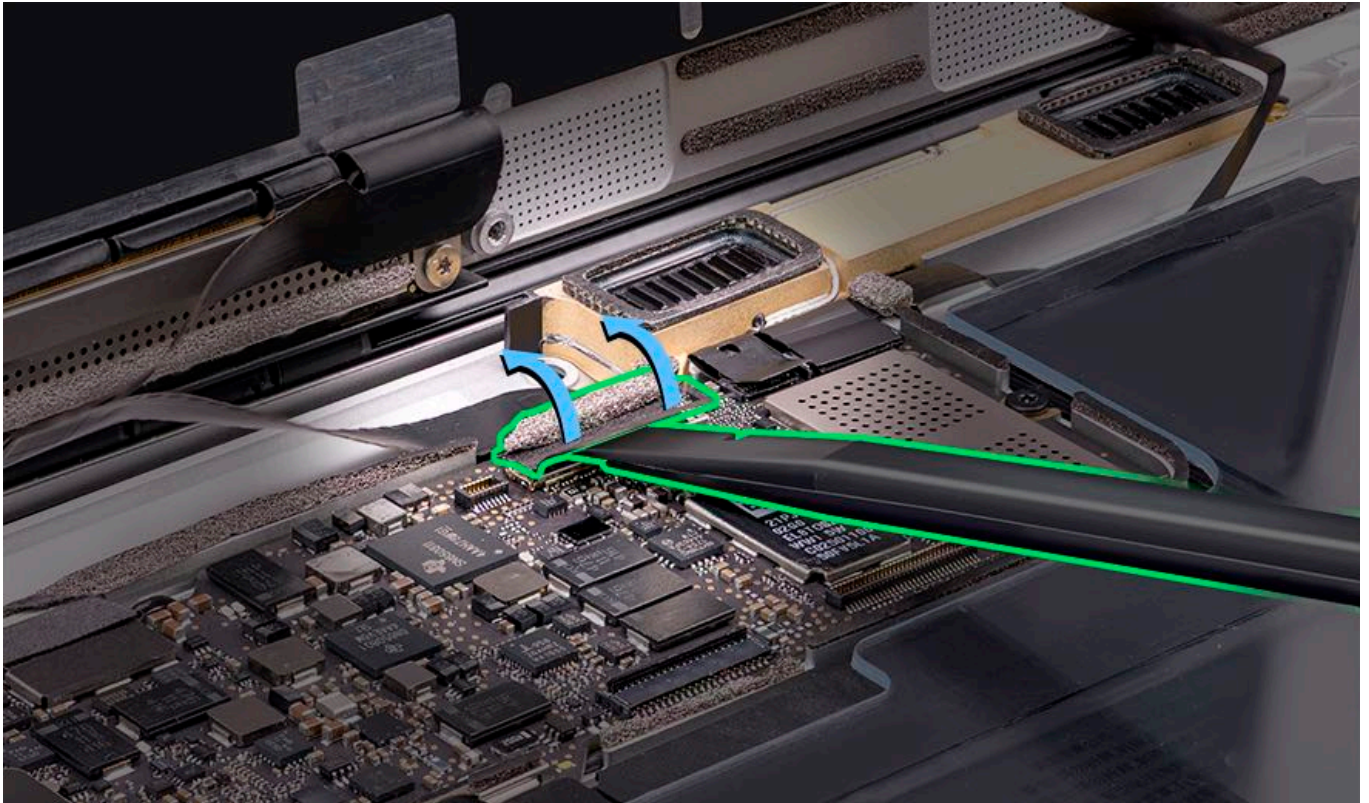
Caution: The next three steps should be followed exactly in order to prevent damage to the thin locking lever connector on the logic board. If the lever is broken, the logic board must be replaced.

19. Lift the EMI tape on the TCON board flex cable connector so that the locking lever is exposed.

20. Hold the locking lever down with the flat end of a black stick.

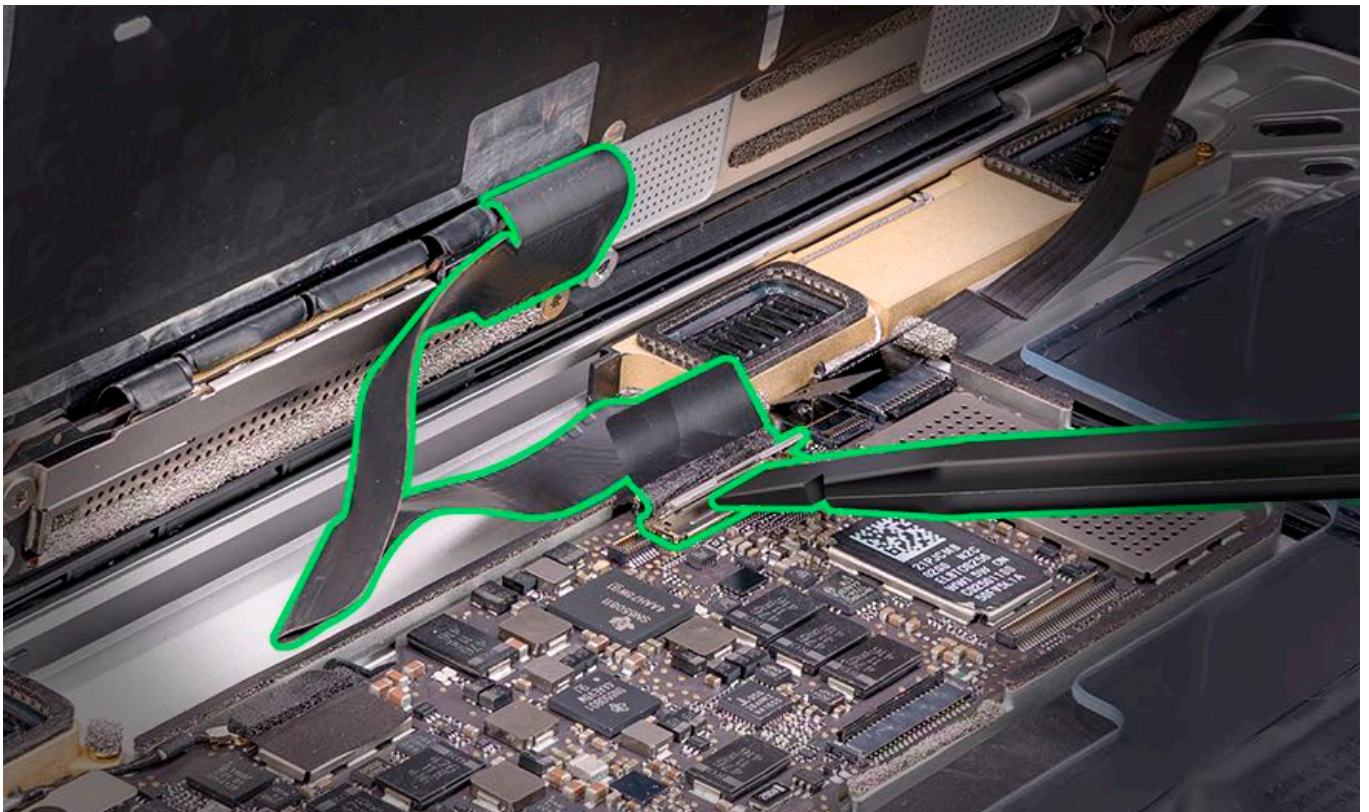
21. Use your fingers to slowly peel the EMI tape back from the connector.

Caution: The locking lever is very thin. Peel gently so as not to break it. If the locking lever is broken, a logic board replacement will be necessary.

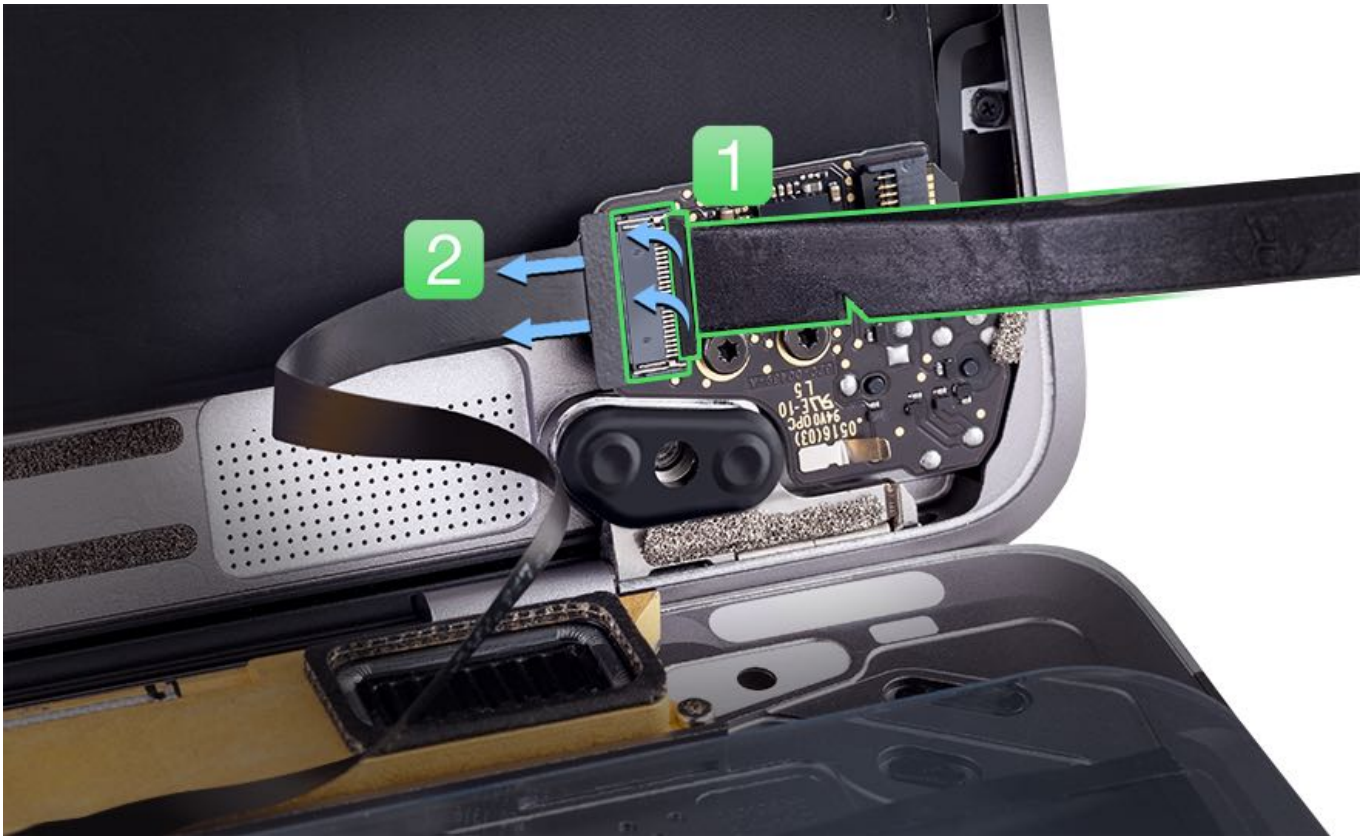


22. Use the flat end of a black stick to lift the locking bar.

23. Disconnect the TCON board flex cable from the logic board.



24. Use the flat end of a black stick to lift the locking lever (1) and then disconnect the audio board flex cable from the audio board (2).



25. Remove two screws from the I/O board flex cable (Early 2015) or I/O board flex cable assembly (Early 2016 and 2017).

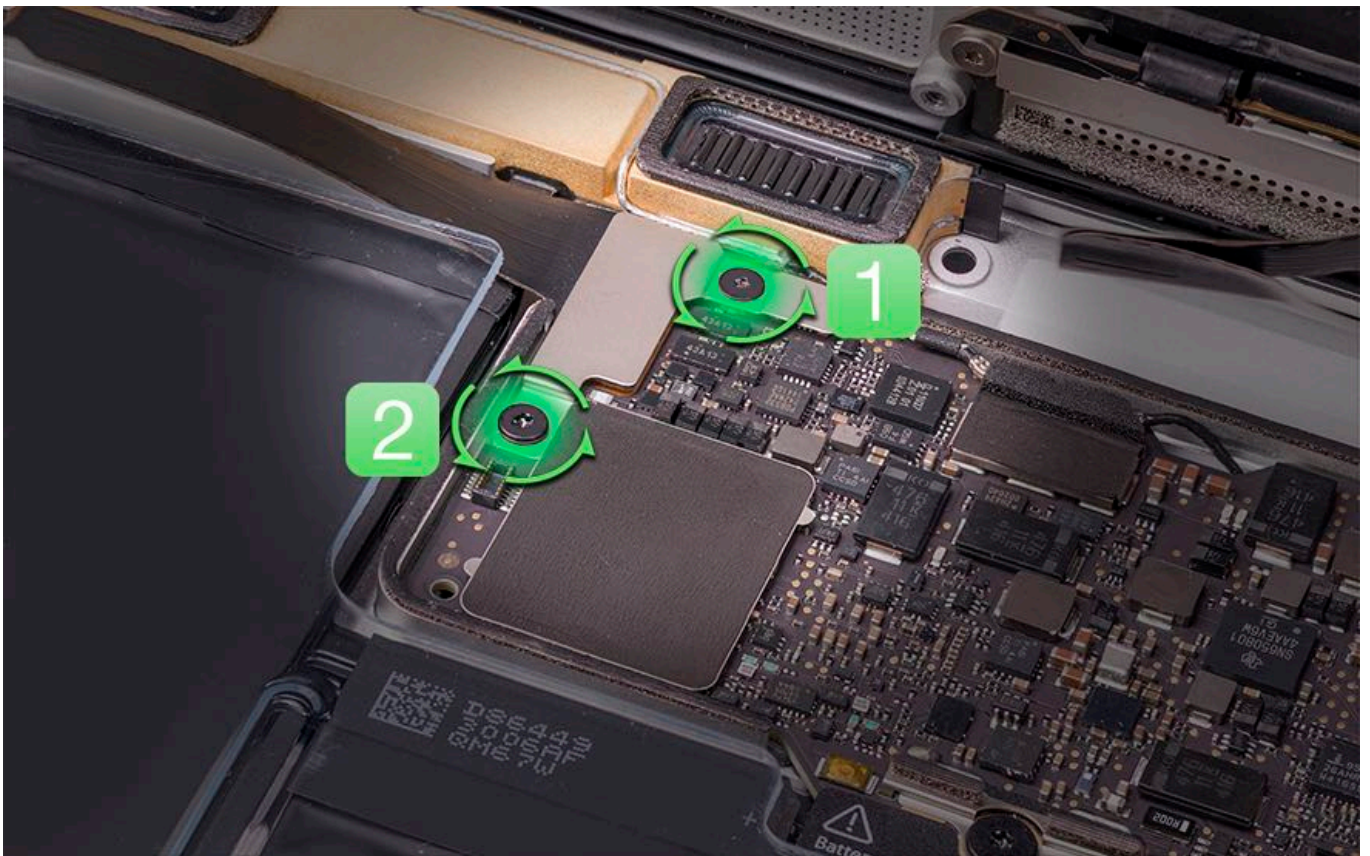
Note: The screw in position 1 may be either a Phillips or a trilobe screw. Check the screw head carefully and make sure the correct screwdriver is well seated before removing the screw. Reuse whichever screw is in place. New inventory for 923-00417 carries the Phillips head screw.

- Phillips #000 or trilobe #00
- 923-00417 (position 1)

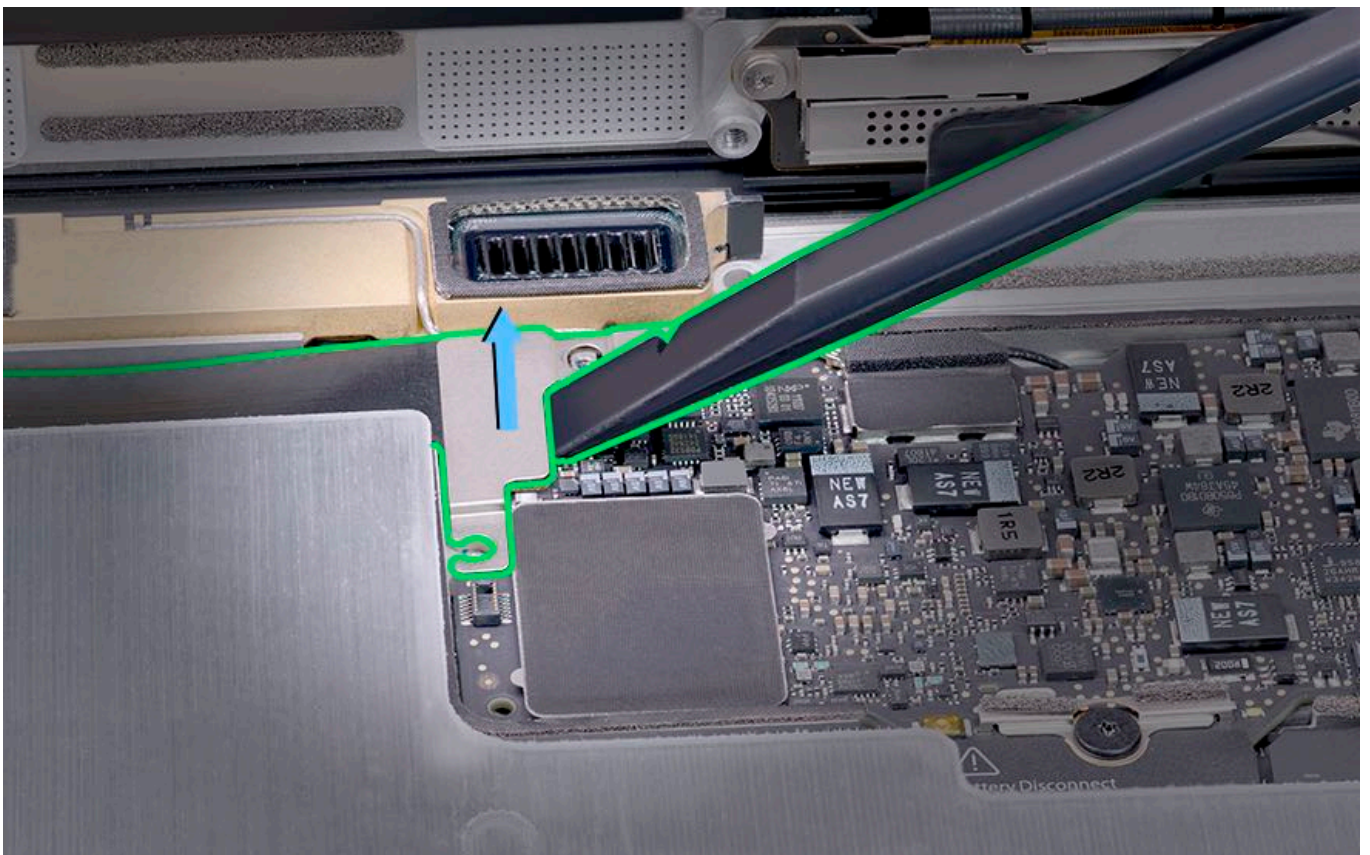


- T5: 923-00419 (position 2)

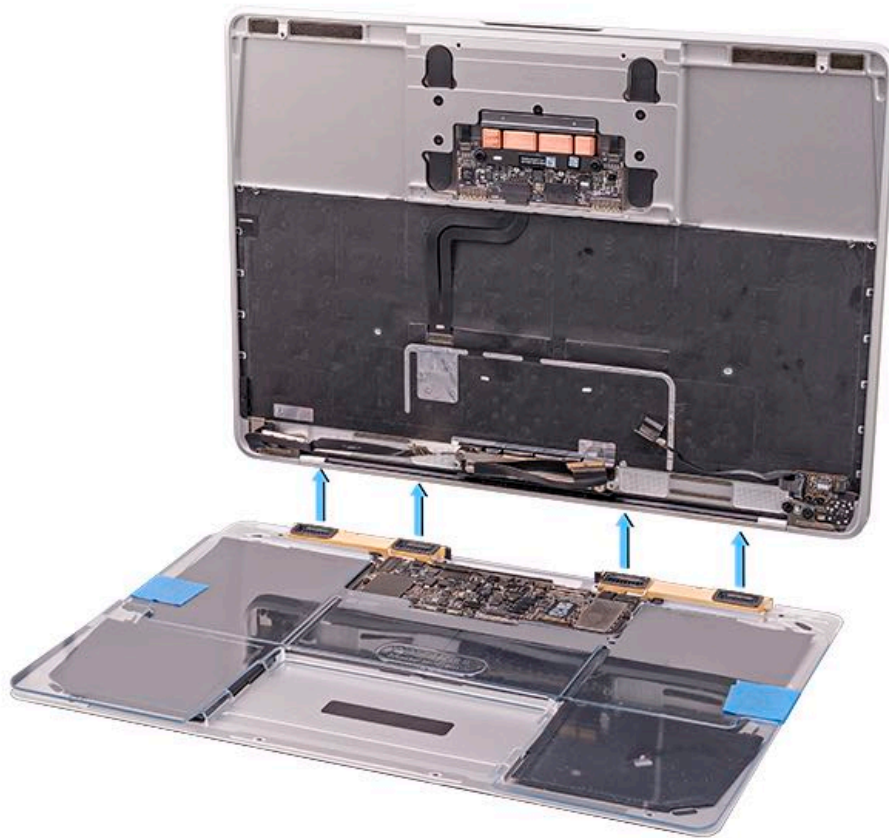




26. Use the flat end of a black stick to disconnect the I/O board flex cable.



27. Separate the top case from the bottom case.



Steps For Reassembly

Note:

- The logic board and speaker/antenna modules must be transferred when installing a replacement bottom case with battery.
- If you are installing a replacement bottom case with battery, use a fine-tip permanent marker to write the original system serial number inside the bottom case. Do not write on the etched sections of the bottom case.
- **Caution:** Before installing the logic board into a replacement bottom case, remove the clear adhesive strips from the thermal interface material in the logic board well. Failure to do so may result in damage that requires a logic board replacement.



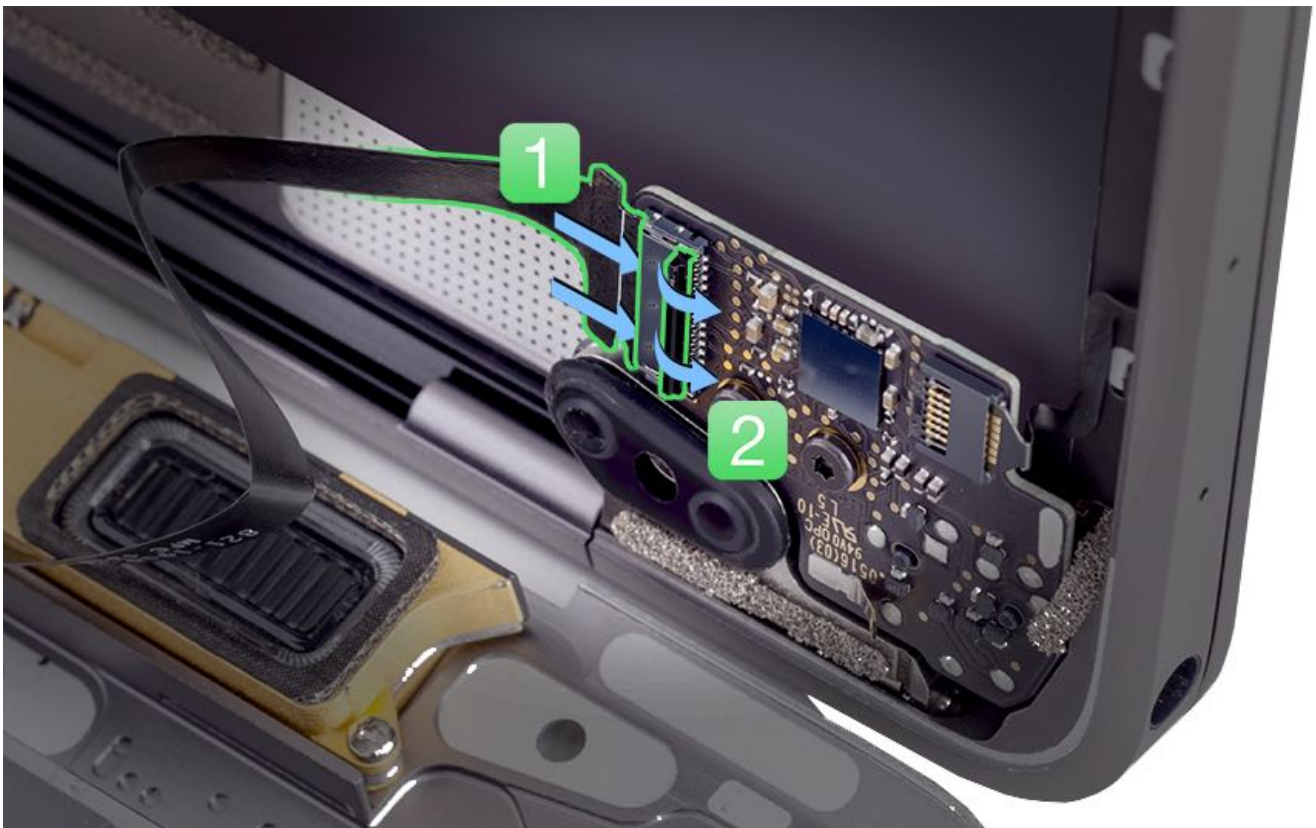
1. Place the bottom case in the service stand.
2. Slide the top case down and settle it into the second level of the service stand.

Caution: Do not set the top case on the speaker/antenna modules. This could cause damage to the speaker cones, resulting in a replacement of the speaker/antenna modules.

3. Align the top case with the bottom case. Ensure that the cables are near the corresponding connectors.



4. Reconnect the audio board flex cable to the audio board (1) and close the locking lever (2).

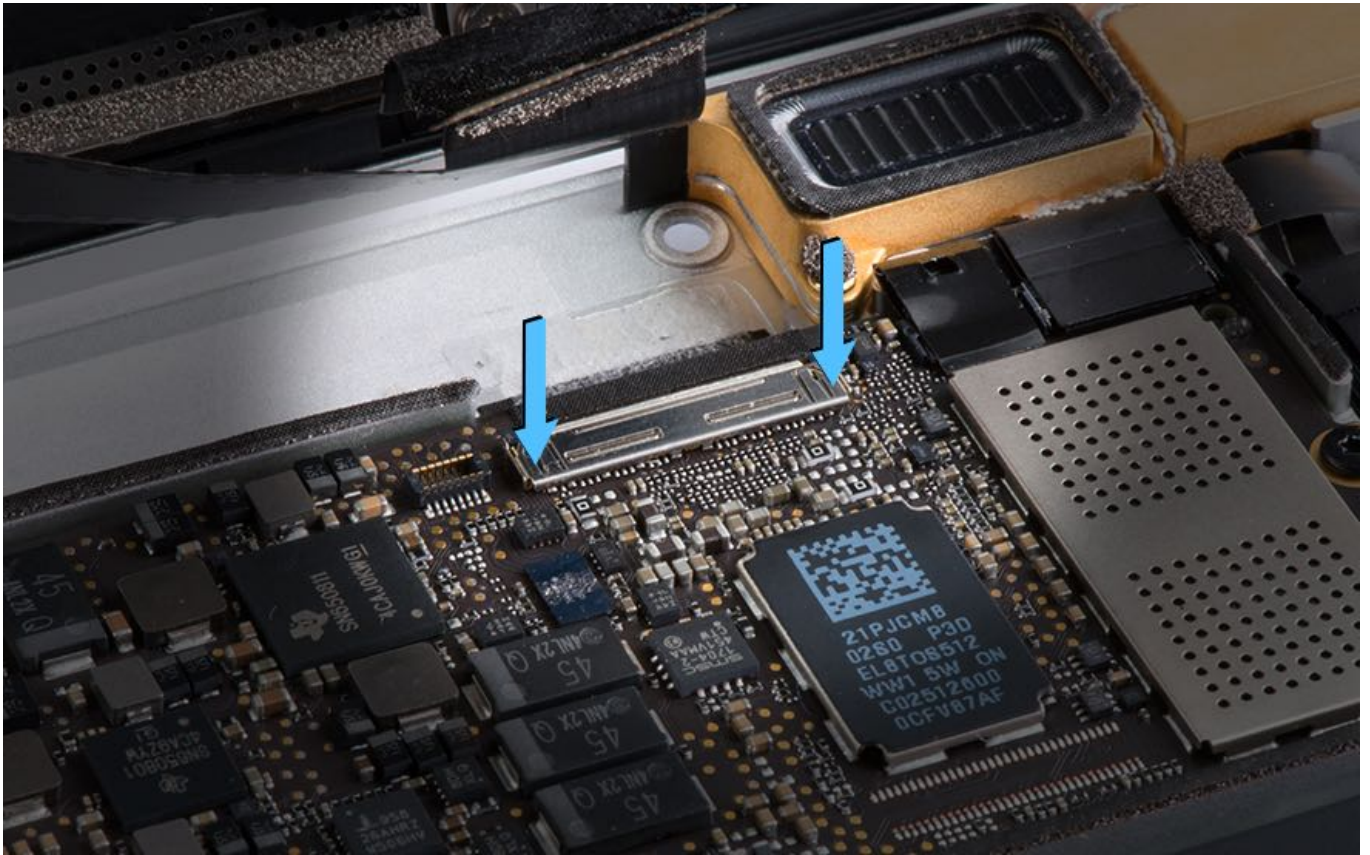


Caution:

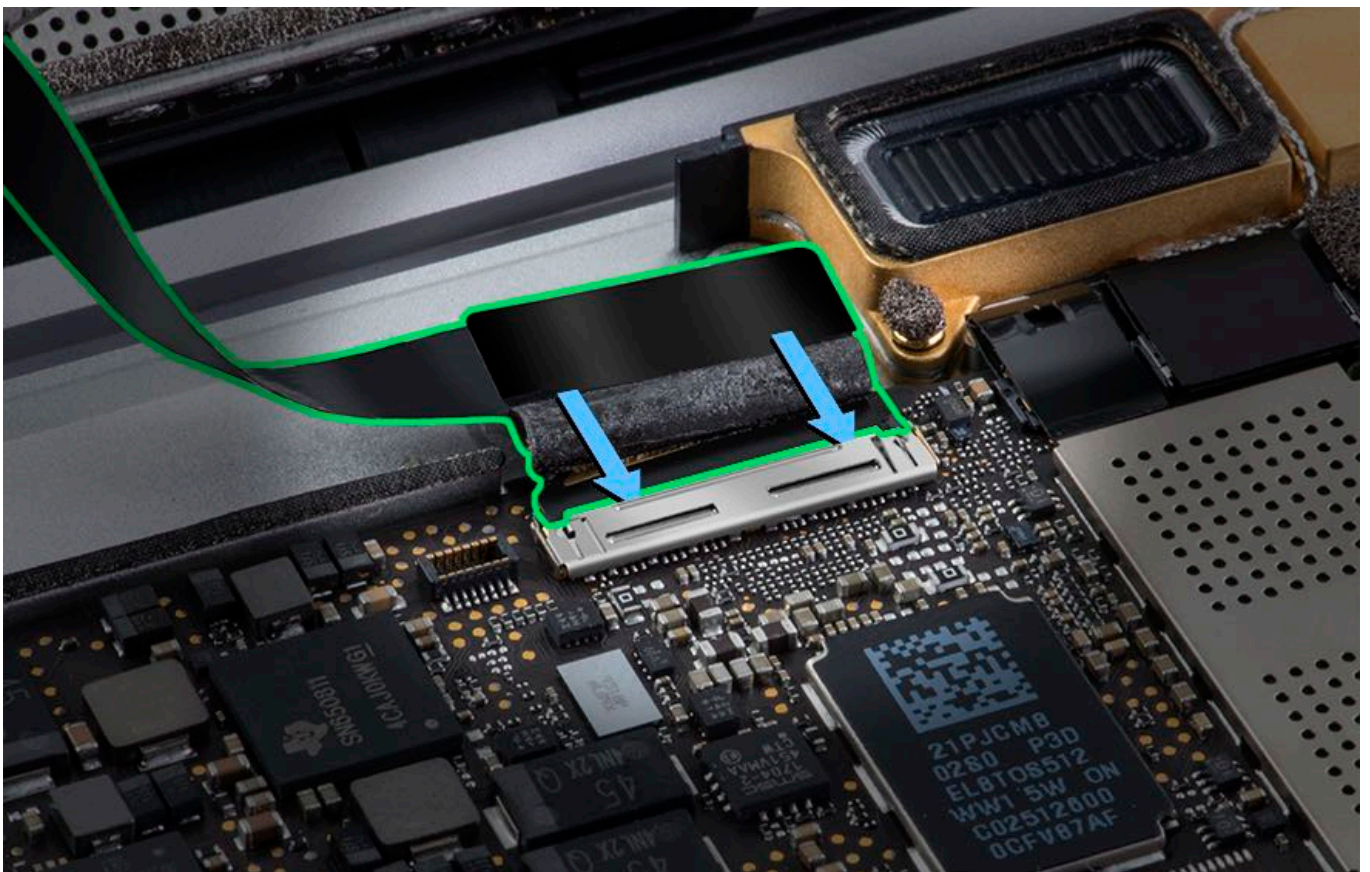
- To avoid damage to the logic board connector, the locking lever for the TCON connector must be **closed** before reinserting the TCON board flex cable. If the connector is damaged, the logic board must be replaced.
- To avoid damage to the locking lever, do not press down in the middle of the lever. If the locking lever breaks, the logic

board must be replaced.

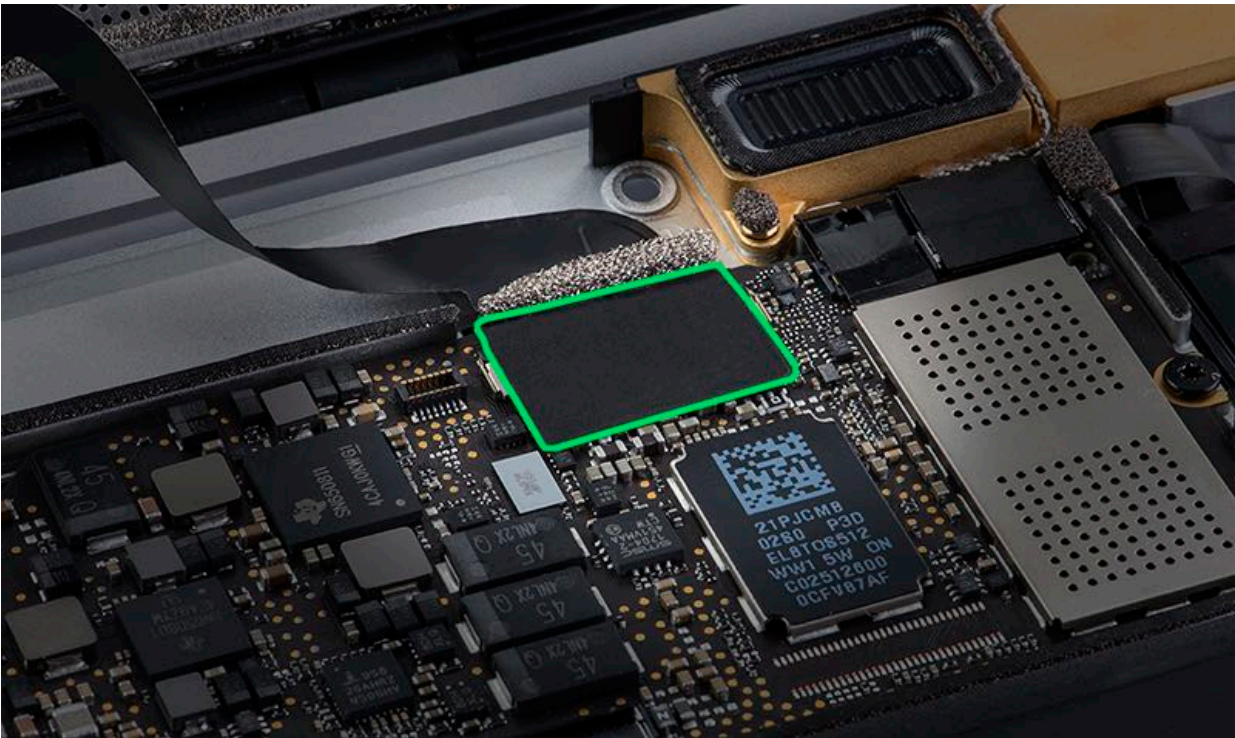
5. To reconnect the TCON board flex cable, first close the connector by gently pressing down on the left side, and then the right side, of the locking lever.



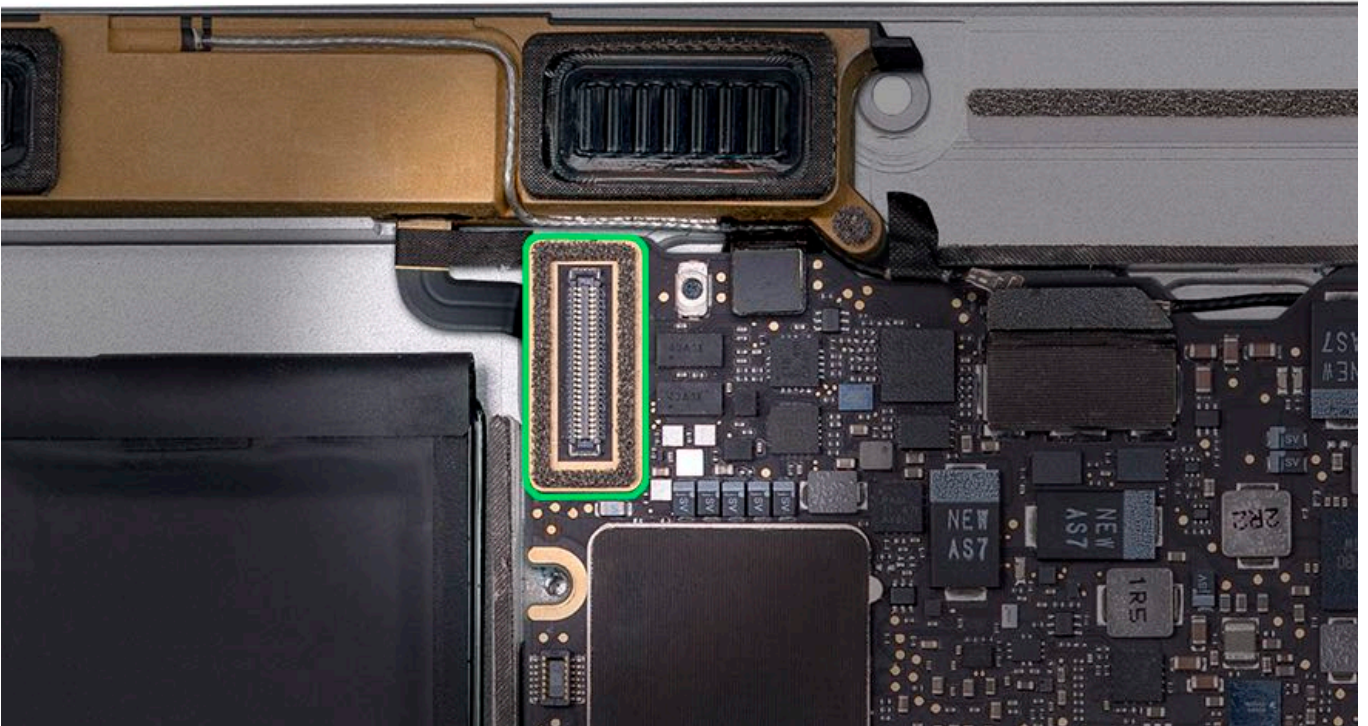
6. Carefully and evenly insert the cable into the **closed** locking lever connector. Be sure the cable is fully inserted and the indentations on the sides of the cable are not visible.



7. Press the tape into place.

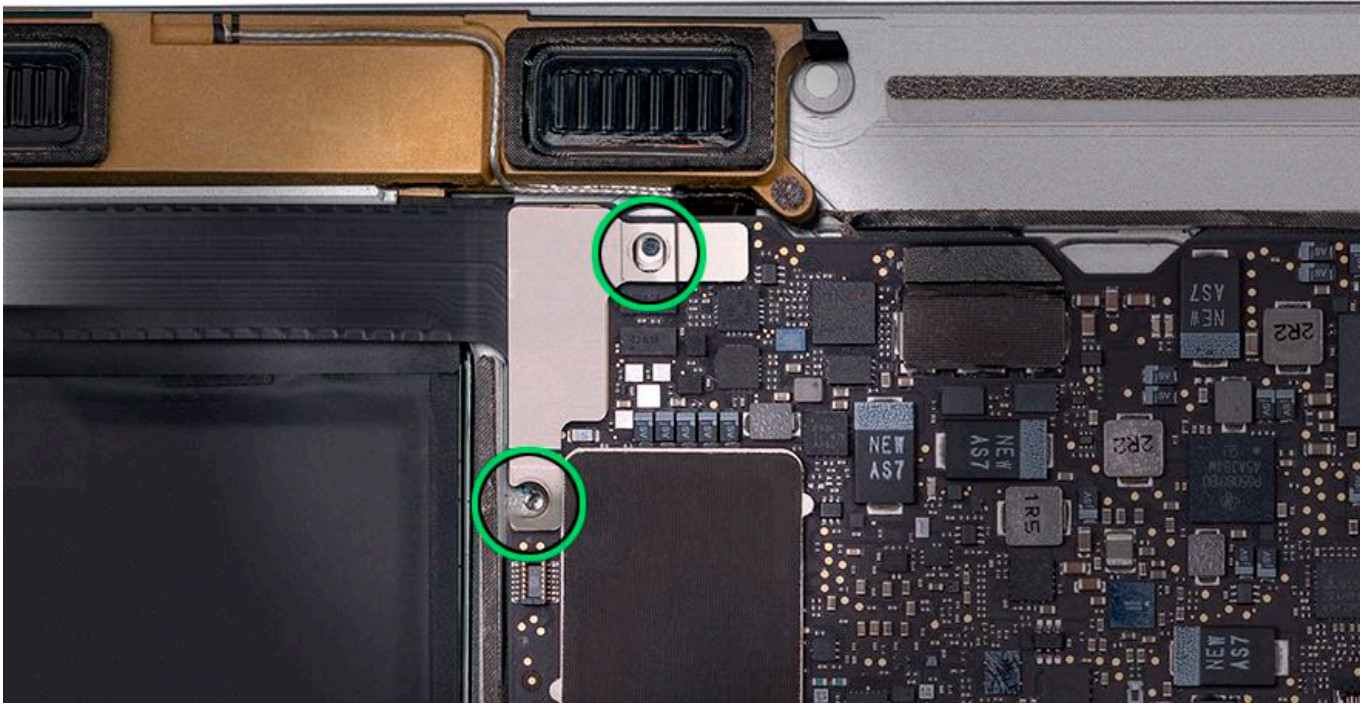


8. Check that the gasket around the I/O board flex cable connector on the logic board is intact and that there is no gasket material in the connector area.



9. Reconnect the I/O board flex cable by aligning the screw holes on the cowling with the openings on the logic board. Press the center of the cowling straight down to seat the connector.

Caution: Failure to align the cable properly can result in damage to the logic board. If there is any resistance connecting the I/O board flex cable, realign the screw holes and try again.



10. Reinstall two screws to the I/O board flex cable. Keep the connector stable by gently pressing down on the cowling while tightening the screws.

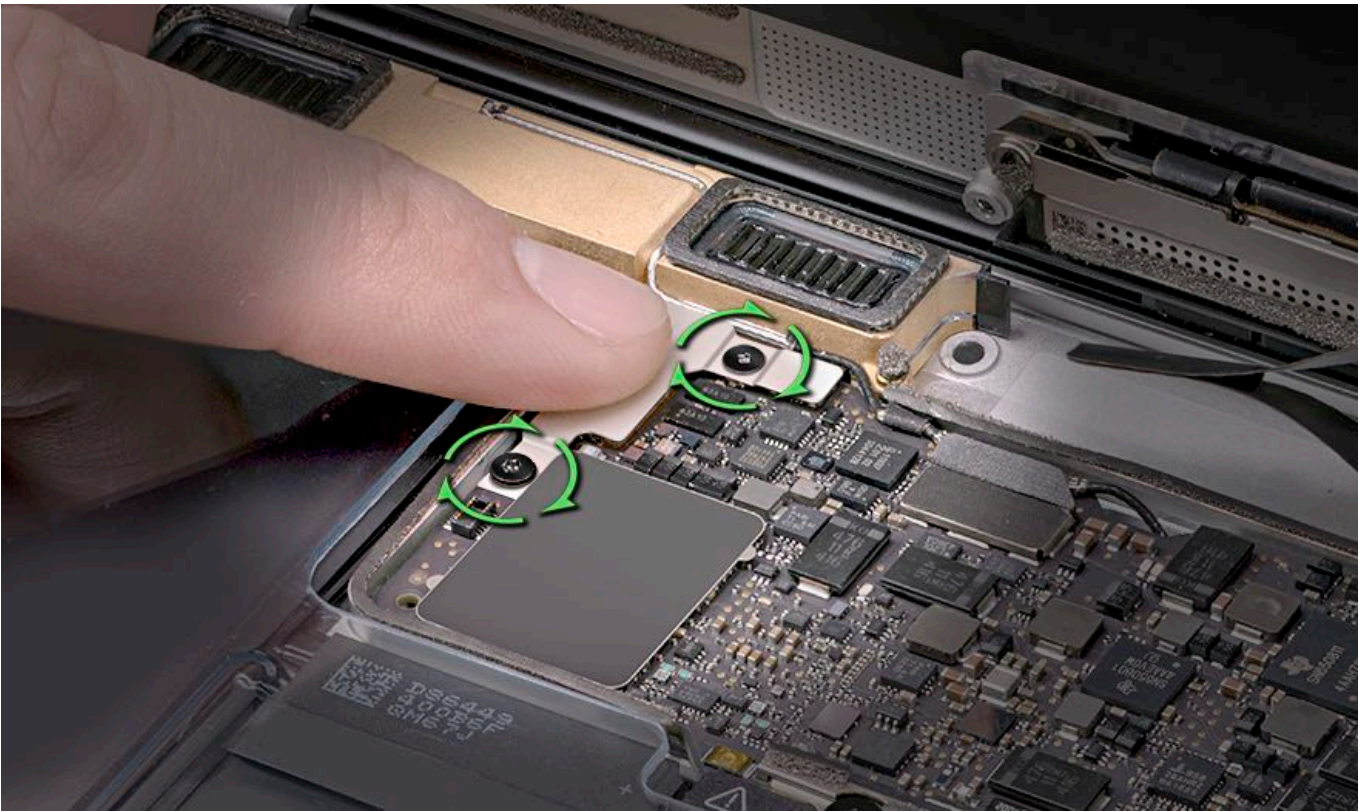
Note: The screw in the top position may be either a Phillips or a trilobe screw. Check the screw head carefully and make sure the correct screwdriver is well seated before turning the screw. Reuse whichever screw is in place. New inventory for 923-00417 has the Phillips head screw.

- Phillips #000 or trilobe #00: 923-00417 (top)



- T5: 923-00419 (left)

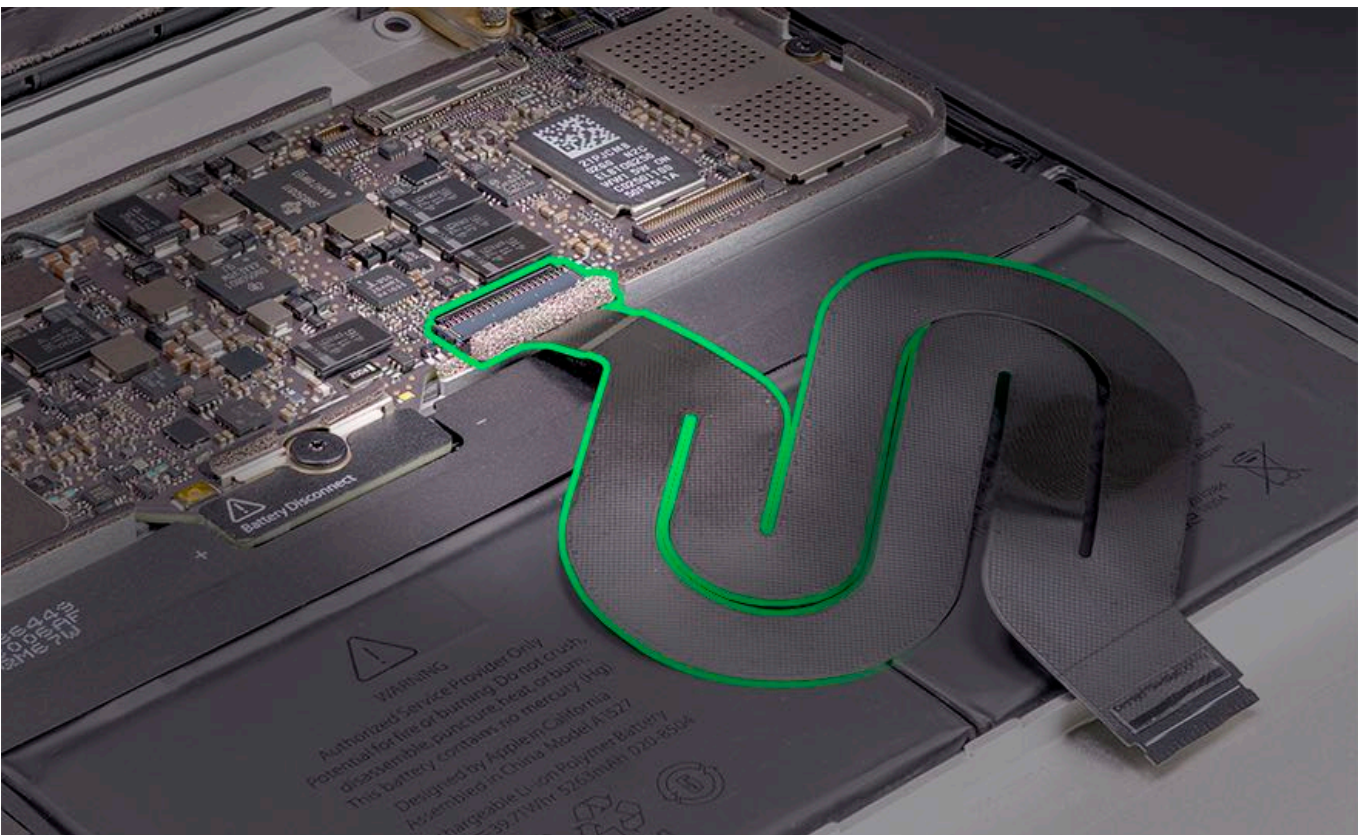




11. Remove the protective battery cover.

12. Connect the IPD to logic board flex cable to the logic board. Check that the silver padding is facing up.

Caution: Ensure that the connector is inserted with the gold side face down on the logic board, and the gold side face up on the trackpad. Reversing this may result in damage to the logic board, the trackpad, or both.



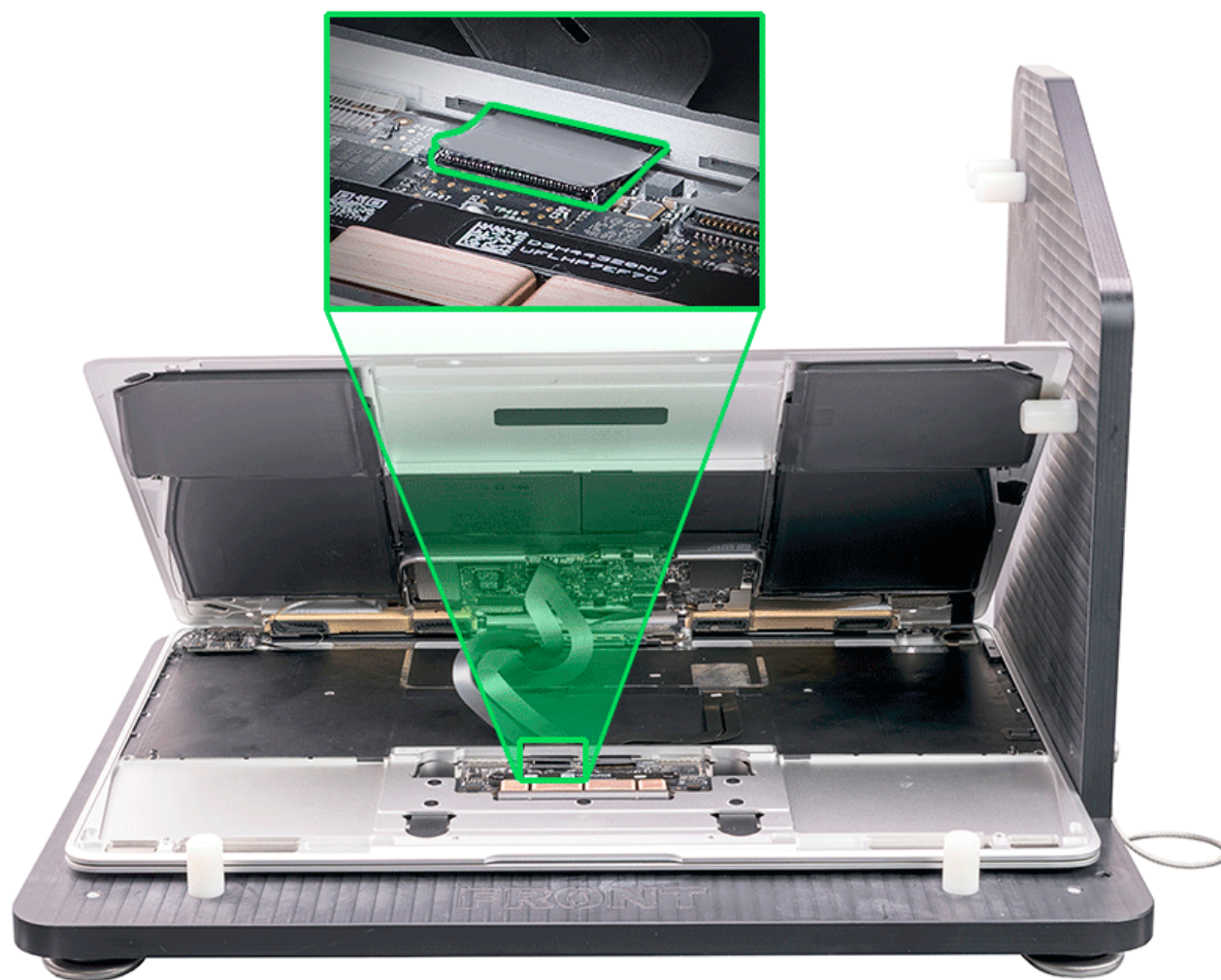
13. Close the computer and remove it from the service stand.

14. Turn the unit over and place it on the base of the service stand.

15. Open the unit to the first level of the service stand.

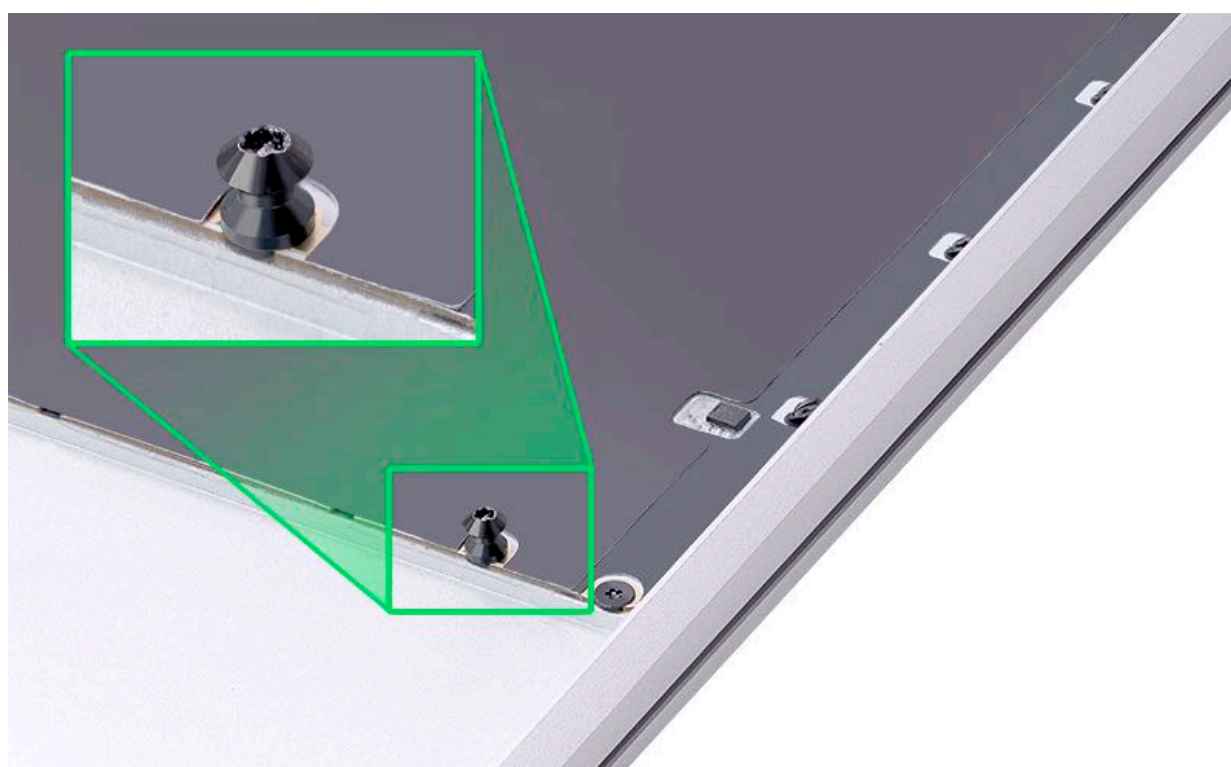
16. Connect the IPD to logic board flex cable to the IPD connector on the trackpad. **Caution:** Be careful that the flex cable

does not get bent when closing the computer.



17. Close the computer and remove it from the service stand.

18. Place the bottom case on the top case. Be careful not to puncture the battery with the mushroom snaps. If a mushroom snap (923-00472) is broken or loose, it must be replaced.



19. Reinstall eight screws to the bottom case in the order indicated. Screws must be removed and installed at an angle.

- Pentalobe: (1.78 mm) (position 1, 2)
 - 923-00415 - silver
 - 923-00431 - space gray
 - 923-00427 - gold
 - 923-01040 - rose gold



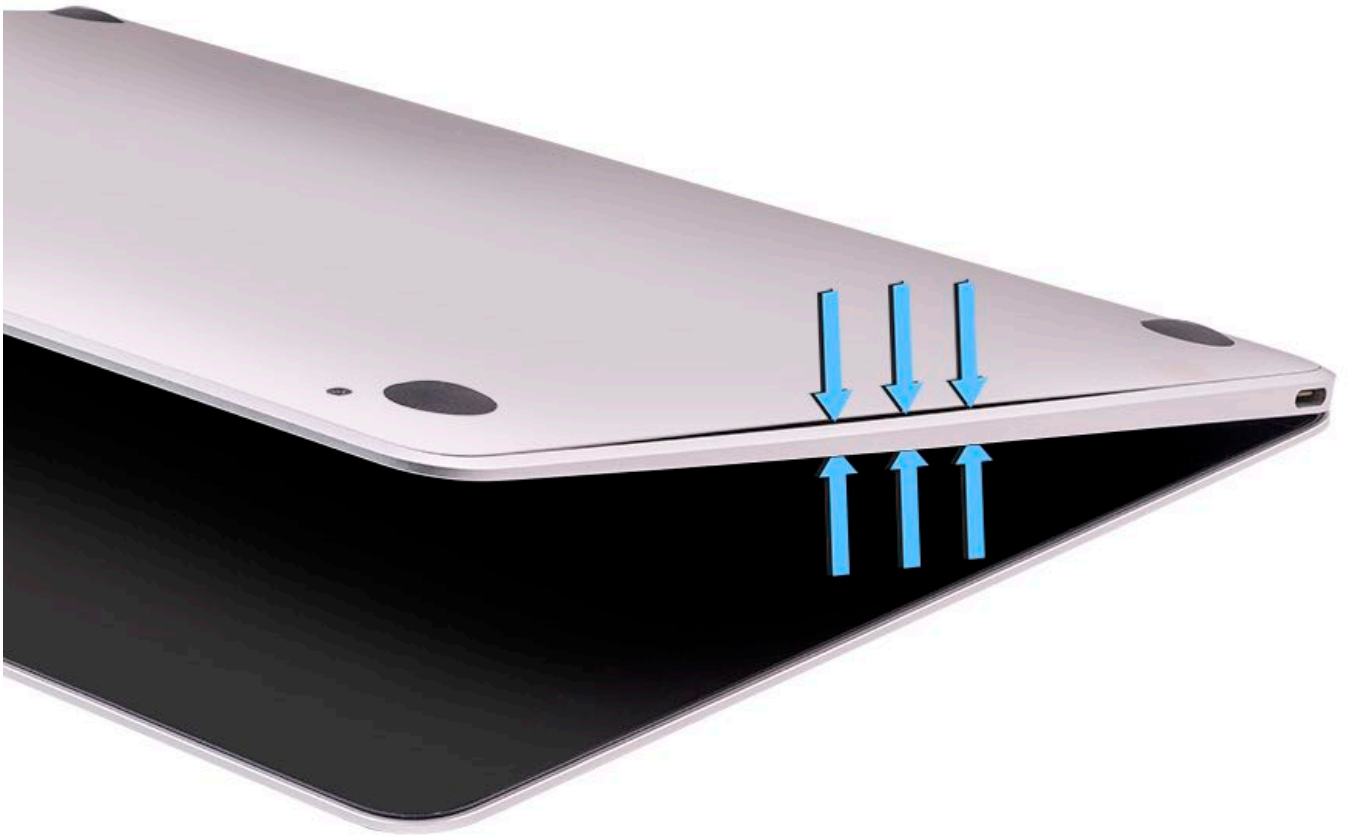
- Pentalobe: (6.23 mm, shoulder) (position 3, 4)
 - 923-00414 - silver
 - 923-00430 - space gray
 - 923-00409 - gold
 - 923-01038 - rose gold



- Pentalobe: (2.95 mm) (position 5, 6, 7, 8)
 - 923-00416 - silver
 - 923-00432 - space gray
 - 923-00406 - gold
 - 923-01039 - rose gold



20. Slightly open the display. Gently press the bottom case and top case together on the right side until you hear a “click” indicating the mushroom snaps have engaged. Repeat on the left side.



21. **For MacBook (12-inch, Early 2016 and 2017):** Press the power button on the keyboard and verify that the computer starts up.

22. **For MacBook (12-inch, Early 2015):** To complete the repair, apply low voltage power to the computer using a USB-C to USB-A cable and a 5W power adapter. It can take up to 10 seconds to hear the power connect sound.



Caution: Failure to apply low voltage power after the repair can result in damage that requires a logic board replacement.

Note:

- If the battery charge remaining is less than 6 percent, then it may take up to 10–15 minutes of charging to hear the power connect sound.
- Once it has been verified that the unit turns on with low power, disconnect the 5W adapter and apply power with the 29W adapter to charge the battery.



23. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad](#)

[Calibration Check.](#)

24. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot.](#)

Input Device (IPD) to Logic Board Flex Cable

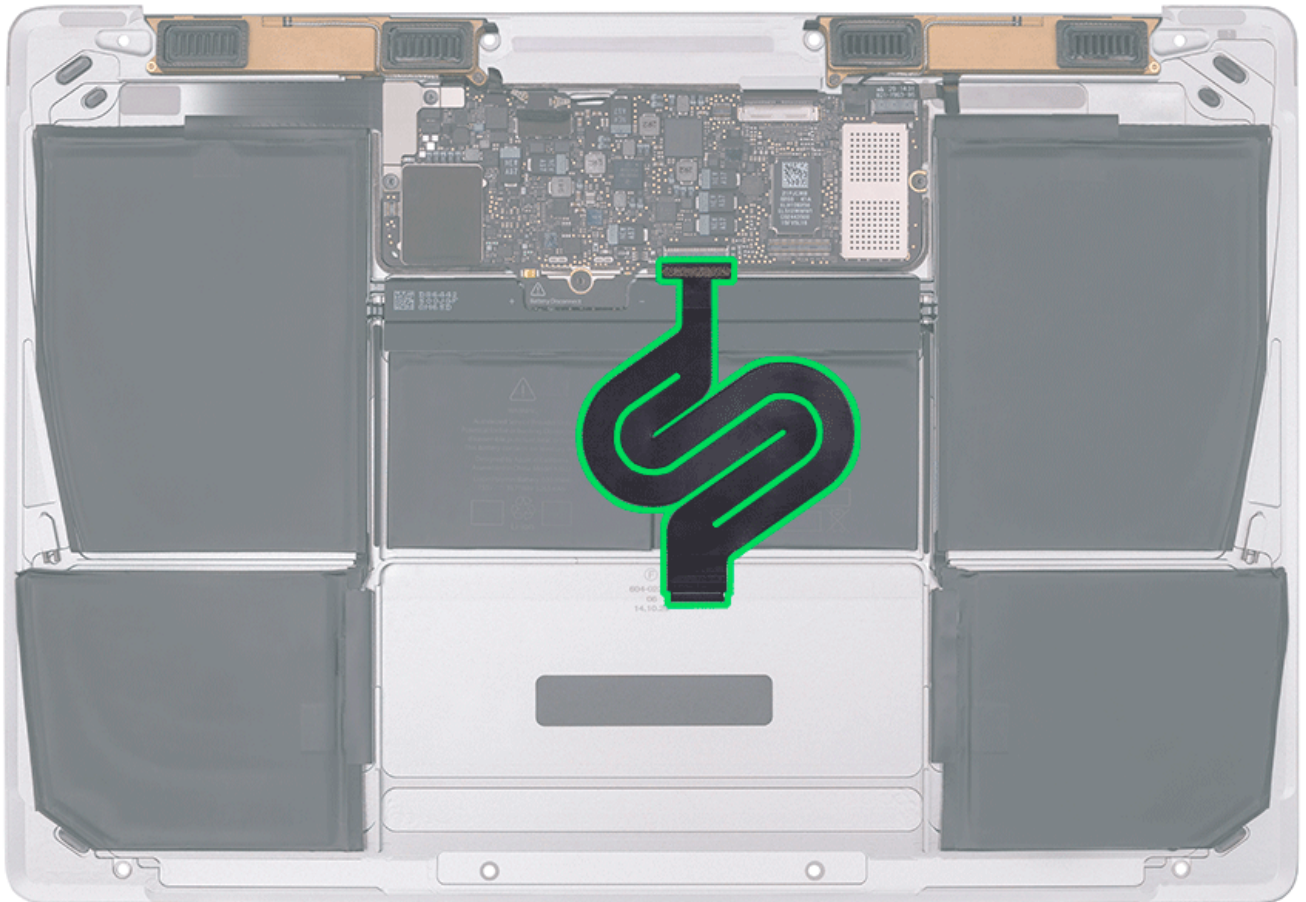
First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)



Tools

No tools required.

Steps For Removal

1. The IPD to logic board flex cable is removed as part of the steps to remove the [bottom case with battery](#).

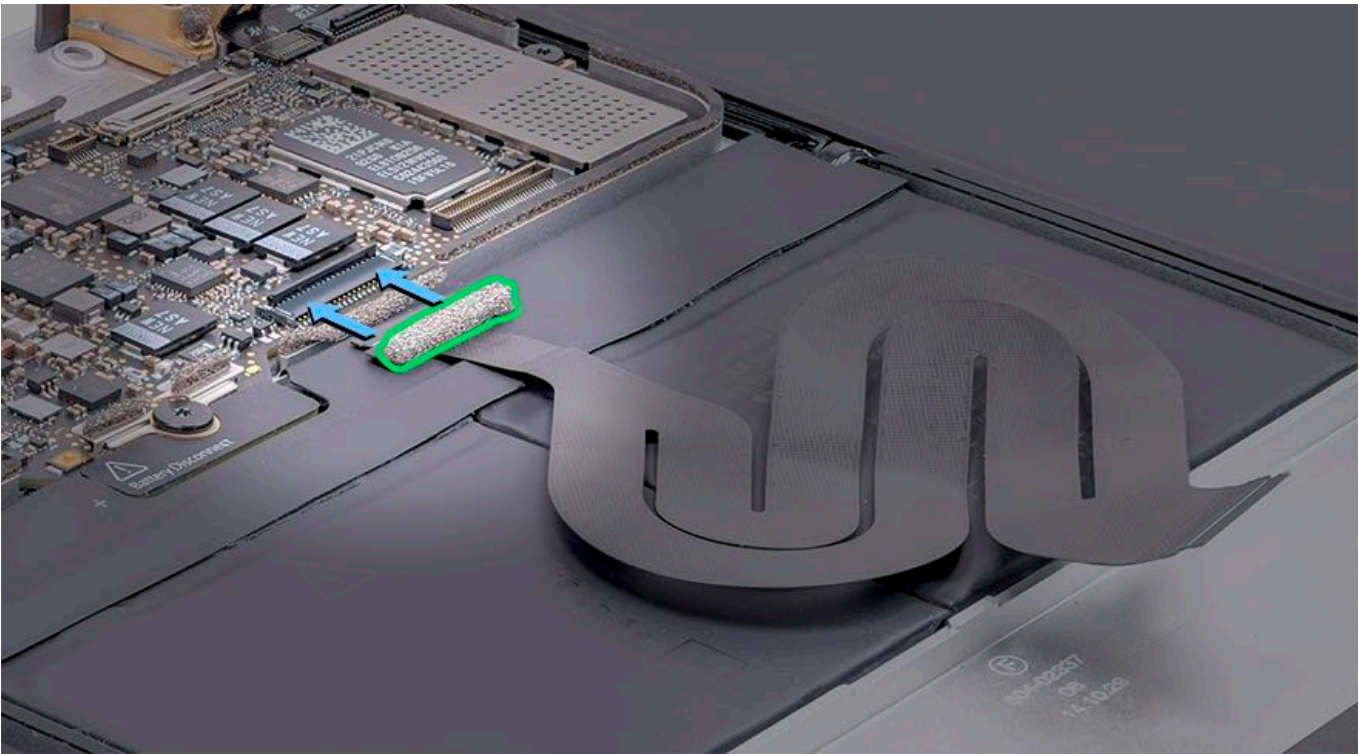
Note: The IPD to logic board flex cable is not interchangeable between MacBook (Retina, 12-inch, Early 2015) and MacBook (Retina, 12-inch, Early 2016 and 2017). When replacing the cable, be sure to order the correct part number for the model that is being repaired.

Steps For Reassembly

1. The IPD to logic board flex cable is reconnected during the reinstallation of the [bottom case with battery](#).

Caution: Be sure the corners of the cable are flat and not bent. The cable may not function properly with bent corners.

Note: When connecting the IPD to logic board flex cable to the logic board, ensure that the side of the cable with the silver foam padding is facing up. Check that the foam padding is not damaged by the connector.



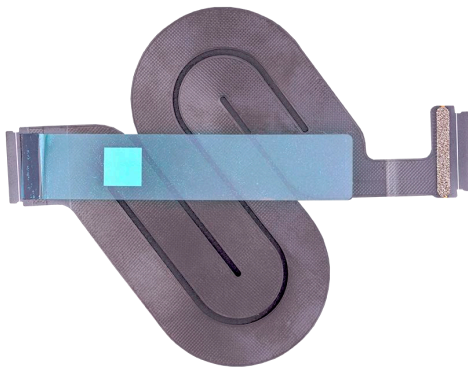
2. The trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

Note: If the IPD to logic board flex cable is not seated properly into the connector, the computer may fail the Trackpad Calibration Check. Double check the cable is inserted fully into the connector before running the test.

3. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Note: When replacing this cable on a Japanese keyboard, refer to the Exploded View for the correct part number:

- [TP1302: Exploded View for MacBook \(Retina, 12-inch, Early 2015\)](#)
- [TP1447: Exploded View for MacBook \(Retina, 12-inch, Early 2016\)](#)
- [TP1573: Exploded View for MacBook \(Retina, 12-inch, 2017\)](#)



Audio Board Flex Cable

First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)

Tools

- ESD wrist strap
- Black stick



Steps For Removal

1. Use the flat end of a black stick to flip the locking lever up to a 90-degree angle (1). Gently remove the flex cable (2).



Steps For Reassembly

1. Slide the connector evenly into the receptacle on the audio board. Lock down the lever after inserting the cable.

Important: When attaching the audio flex cable to the audio board, ensure that the gold side faces downward.

2. Reinstall the [bottom case with battery](#).

3. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

4. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Logic Board

First Steps

Important:

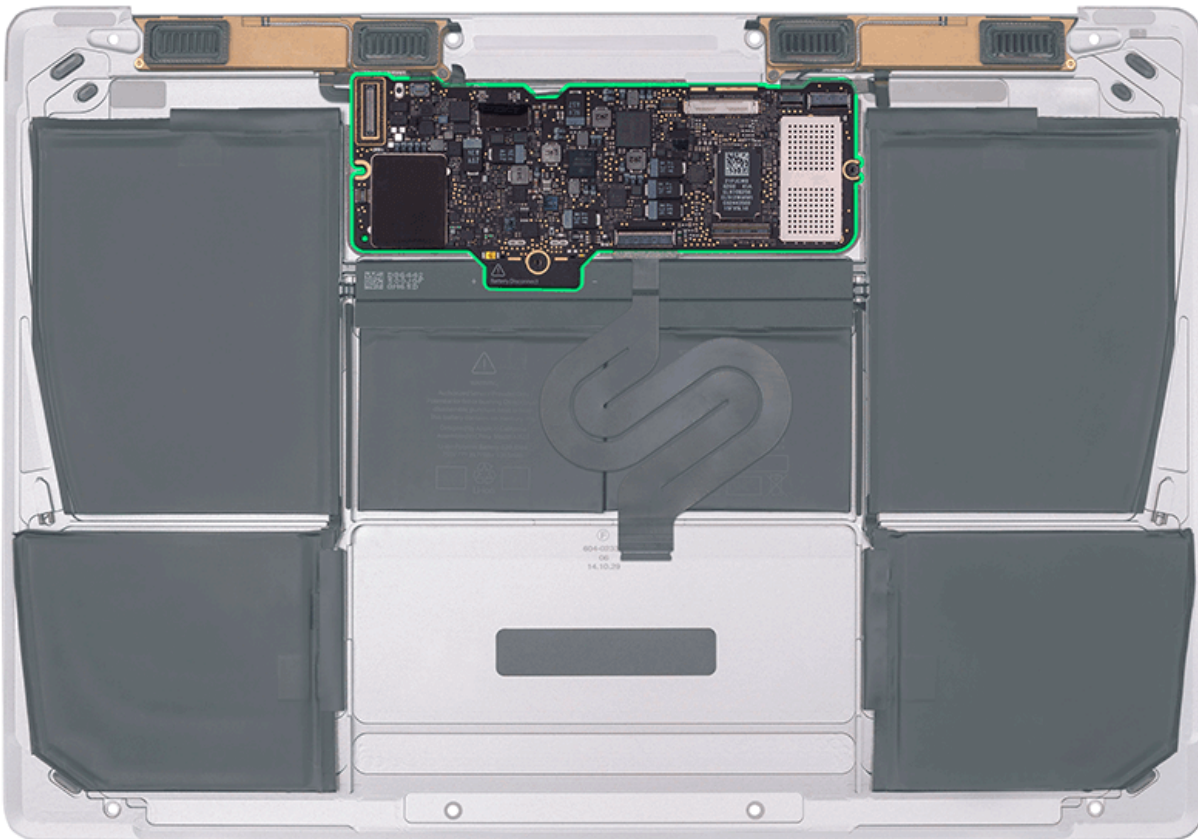
- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

For video instruction, refer to article [SV276: Logic Board Replacement Video](#).

Remove:

- [Bottom case with battery](#)

Note: The thermal interface pads must be replaced each time the logic board is removed.



Tools

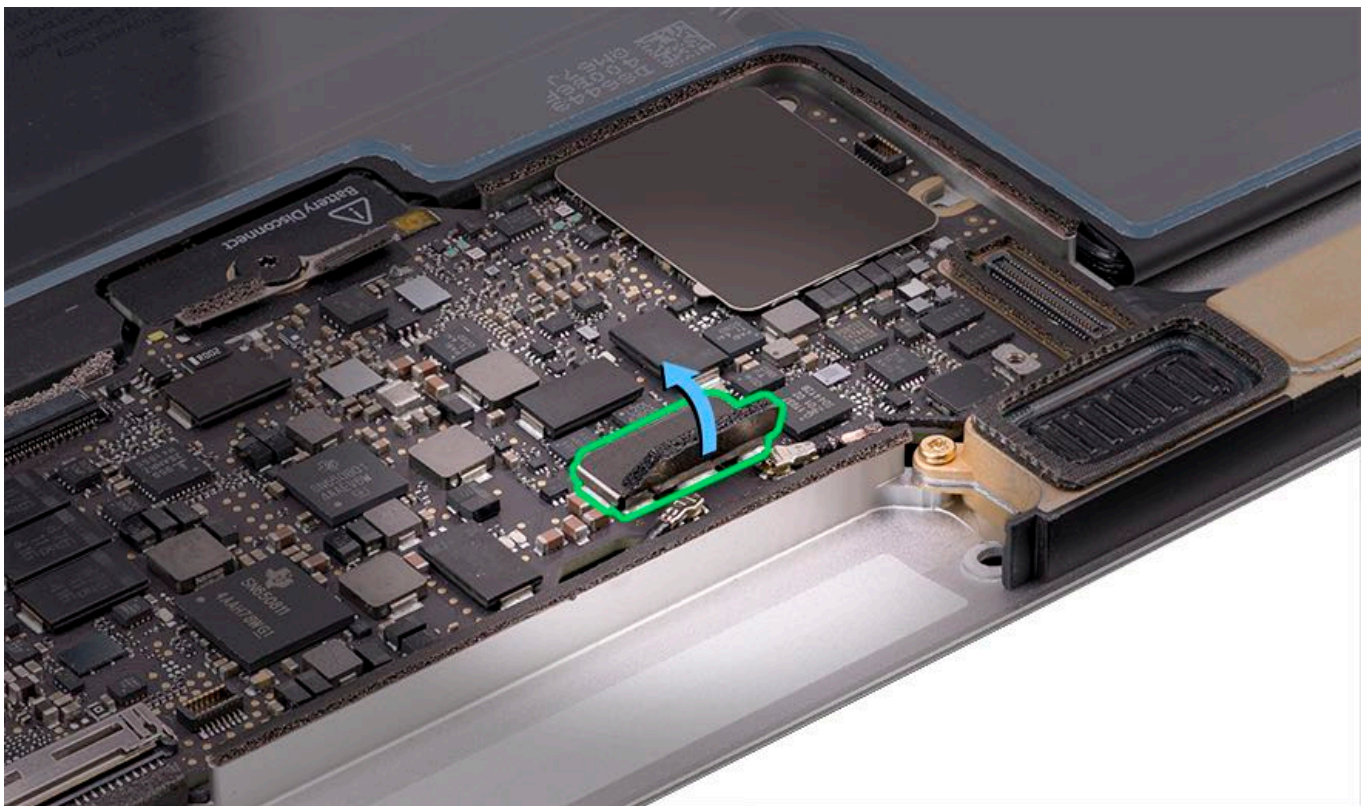
- ESD wrist strap
- Black stick
- Torx T5 screwdriver
- Flat-tip tweezers (for wireless antenna cables and Mylar tape)
- Isopropyl alcohol (IPA) wipes
- Antenna tool (923-01322)



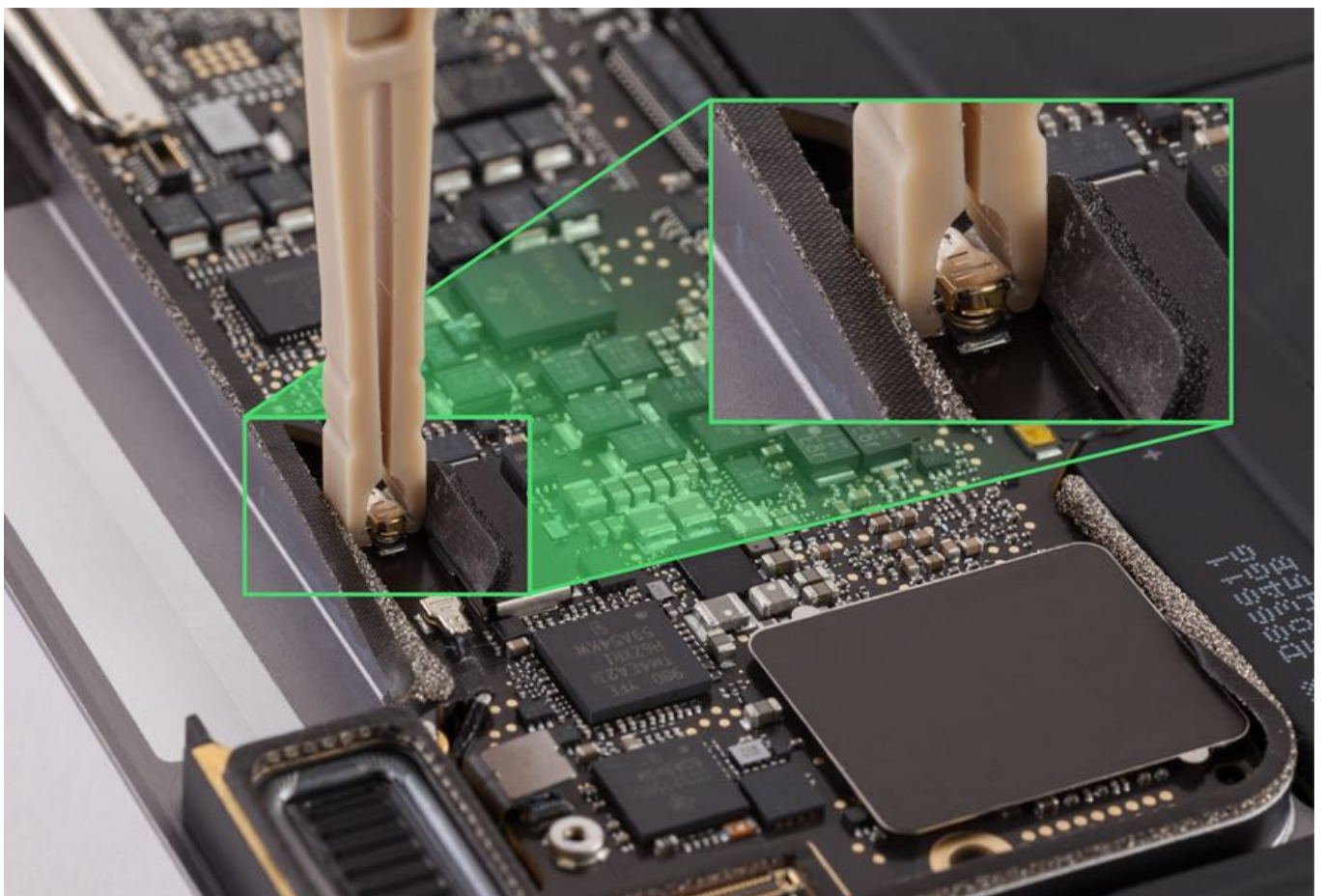
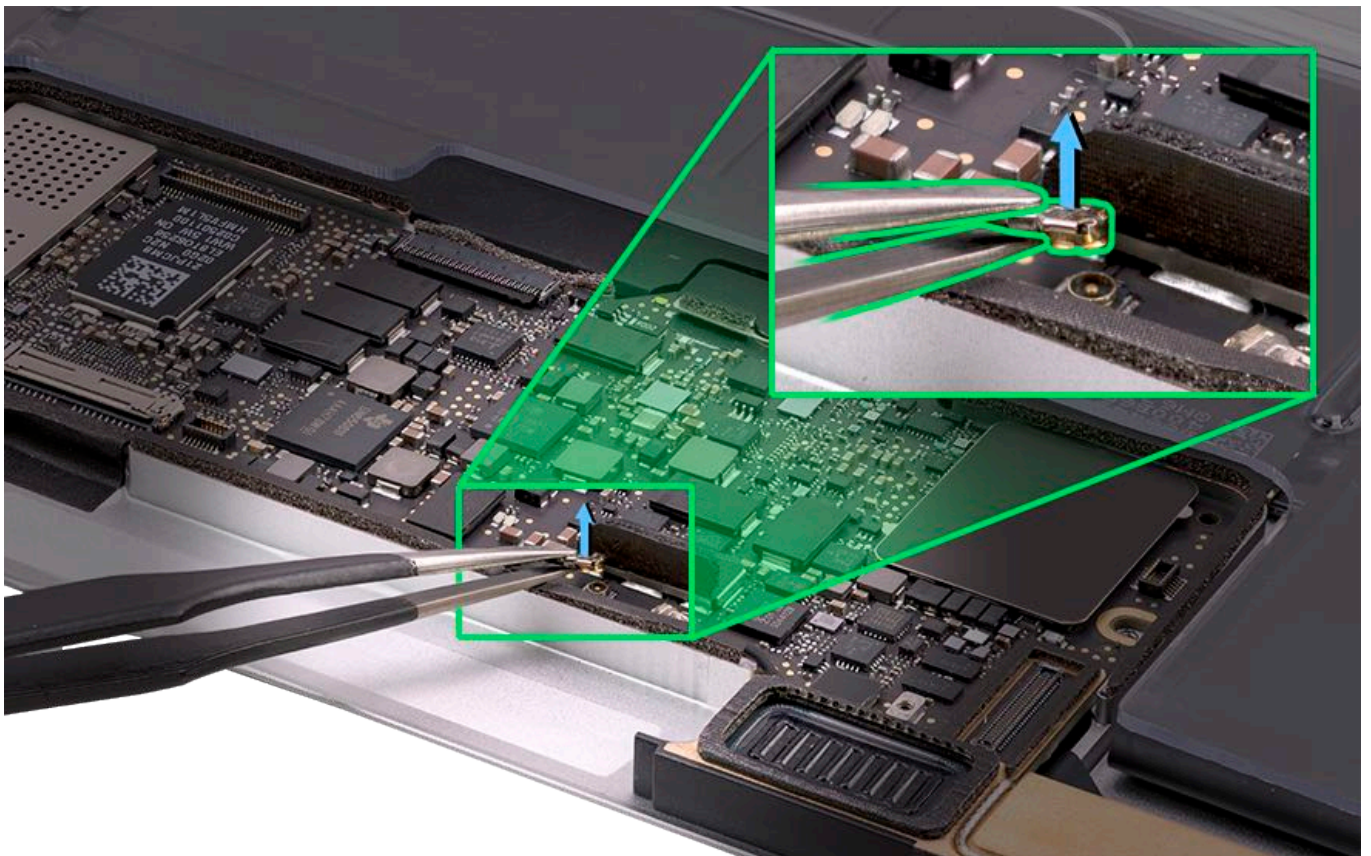
Steps For Removal

Note: The logic board includes onboard flash storage, memory, and wireless card. Before replacing a logic board, be sure to order an identical replacement part.

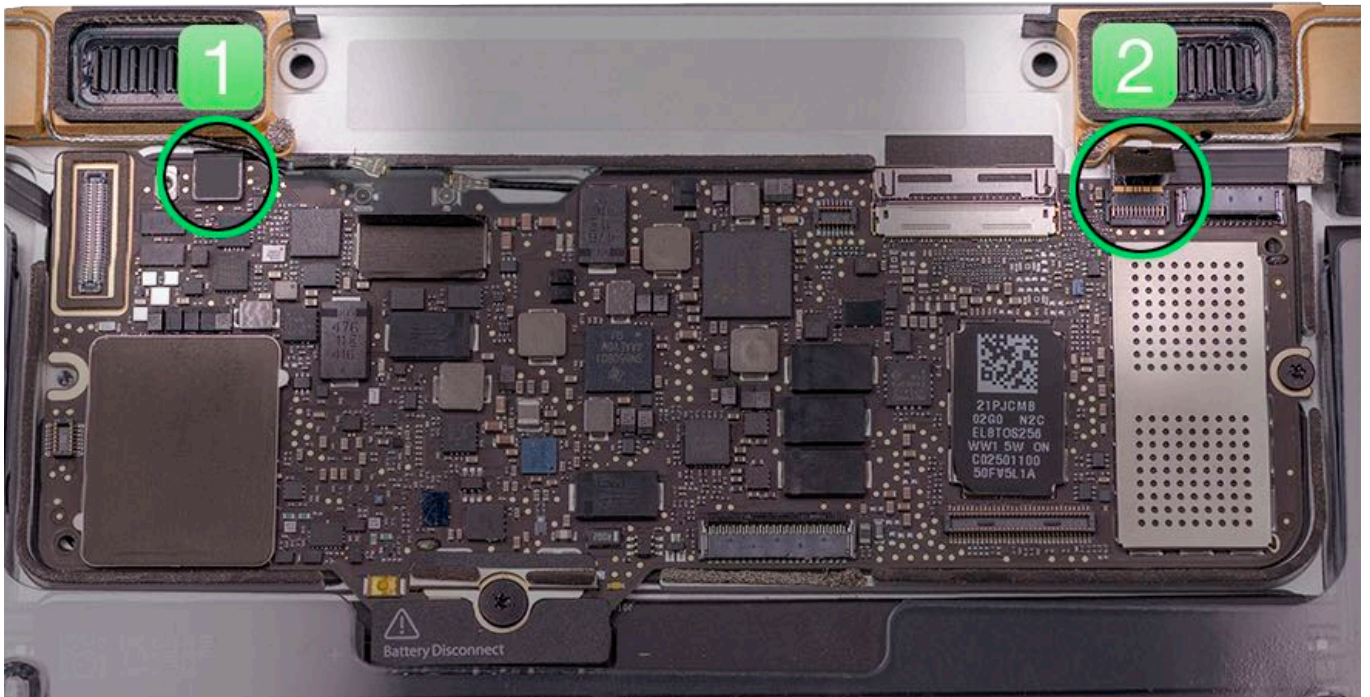
1. Use the tip of a black stick to lift up the foam that covers the wireless antenna cables. If foam is lost or damaged, replace with new foam that is included with replacement logic board.



2. Disconnect the wireless antenna using either a tweezer or the antenna tool.



3. Use the flat end of a black stick to gently disconnect the left speaker cable from the platform connector (1). Gently lift the locking lever on the right speaker cable connector and remove the cable (2).



4. Remove two logic board screws.

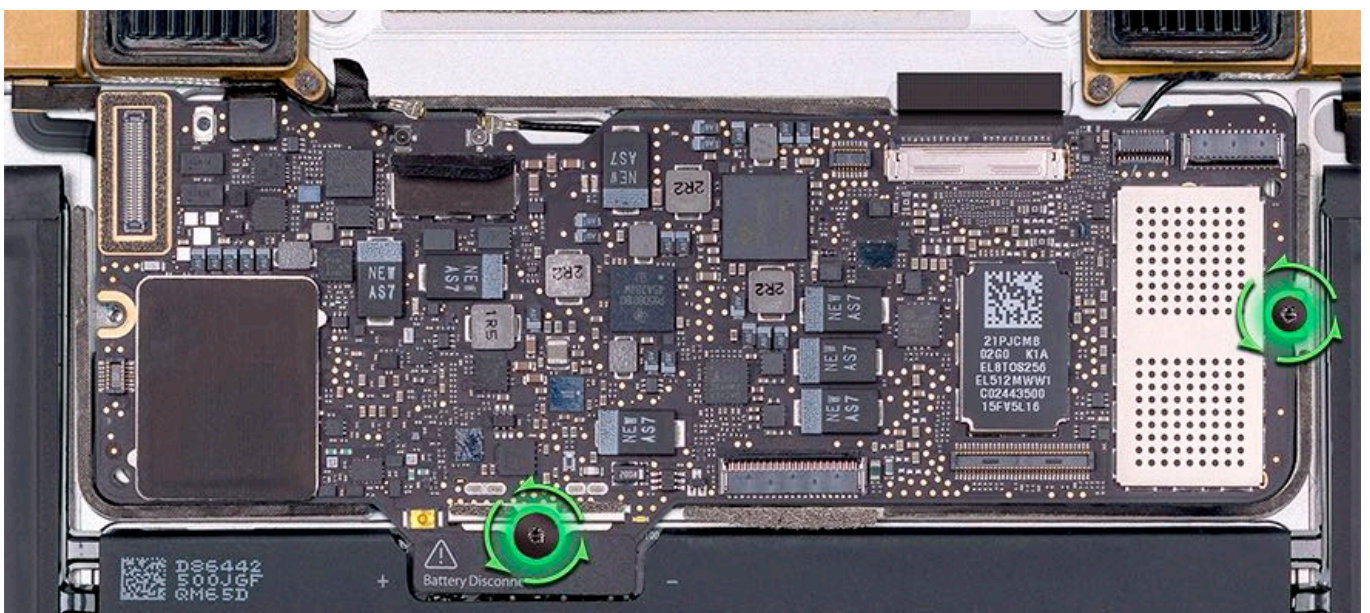
- T5: 923-00419 (right)



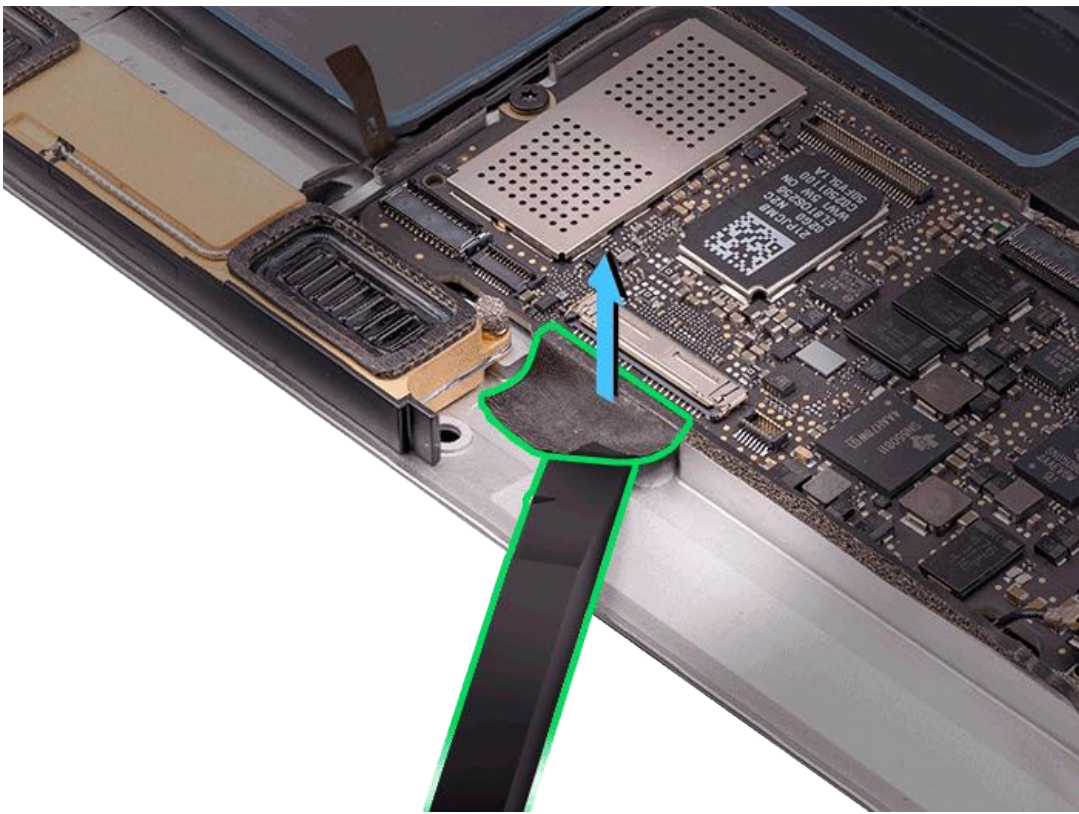
- T5: 923-00425 (bottom)



Note (Early 2015 only): The bottom screw has a ground clip (923-00470) that is also removed.

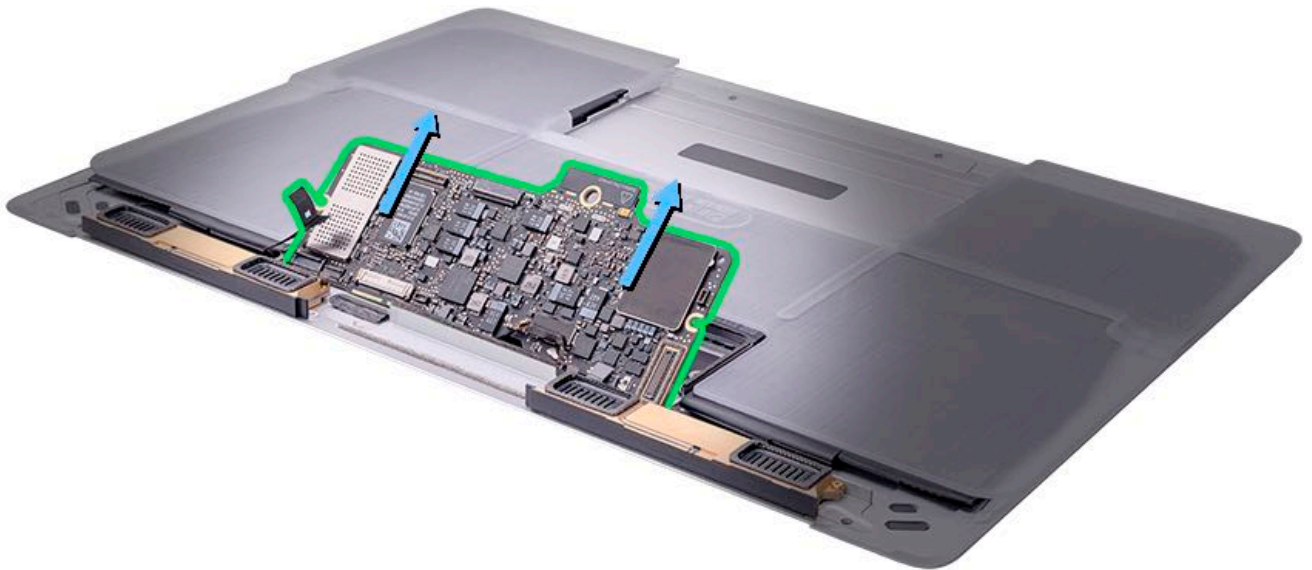


5. Use a black stick to peel off the thin piece of EMI tape on the logic board near the timing controller (TCON) connector. Replacement EMI tape will be included with the replacement logic board.



6. Tilt up the logic board and slide the board out of the bottom case.

Caution: Hold the logic board by the edges and do not touch the gold pins.



Steps For Reassembly

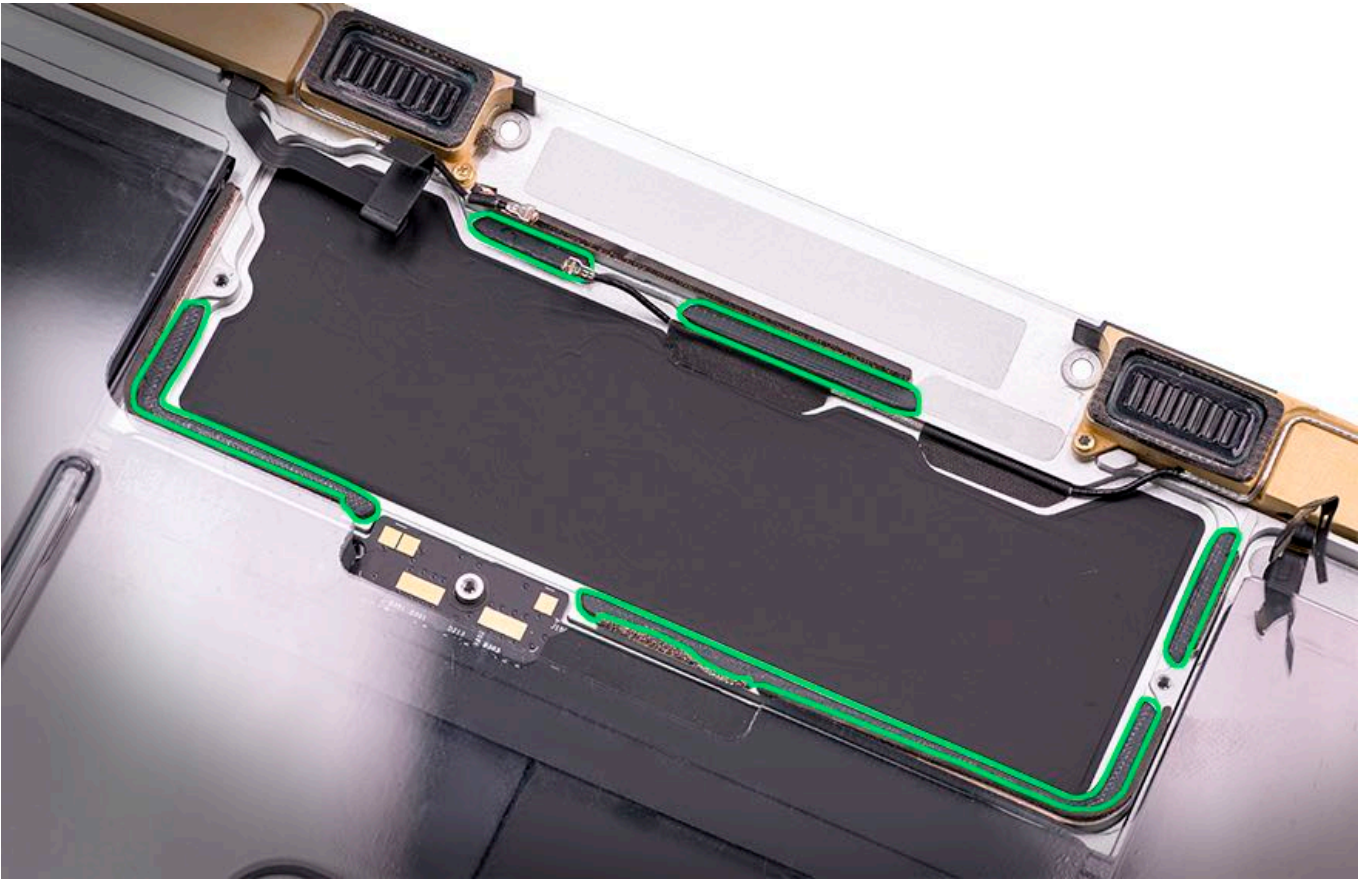
1. Remove the existing thermal interface pads.
2. Wrap an IPA wipe around the pointed end of a black stick and clean off the excess adhesive.



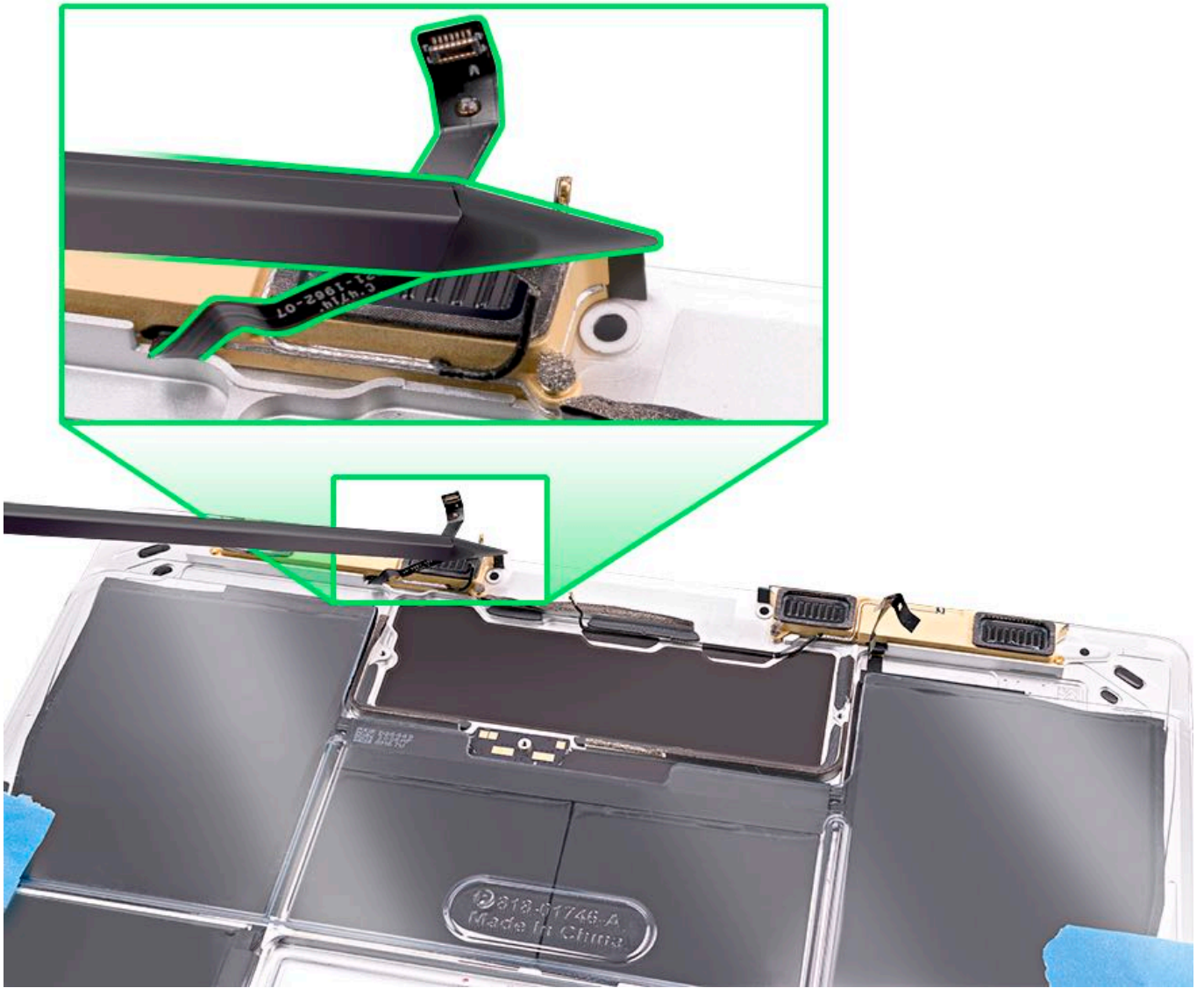
Caution: Do not get alcohol on the gold BMU connectors or the graphite surface in the logic board area. Do not scratch the graphite surface. If the graphite surface is damaged, the bottom case with battery must be replaced.

3. After the alcohol has dried, apply new thermal interface pads to the areas outlined in green.

Note: Two sets of thermal interface pads are included with the replacement logic board. If the pads do not align correctly on the first try, use the second set.

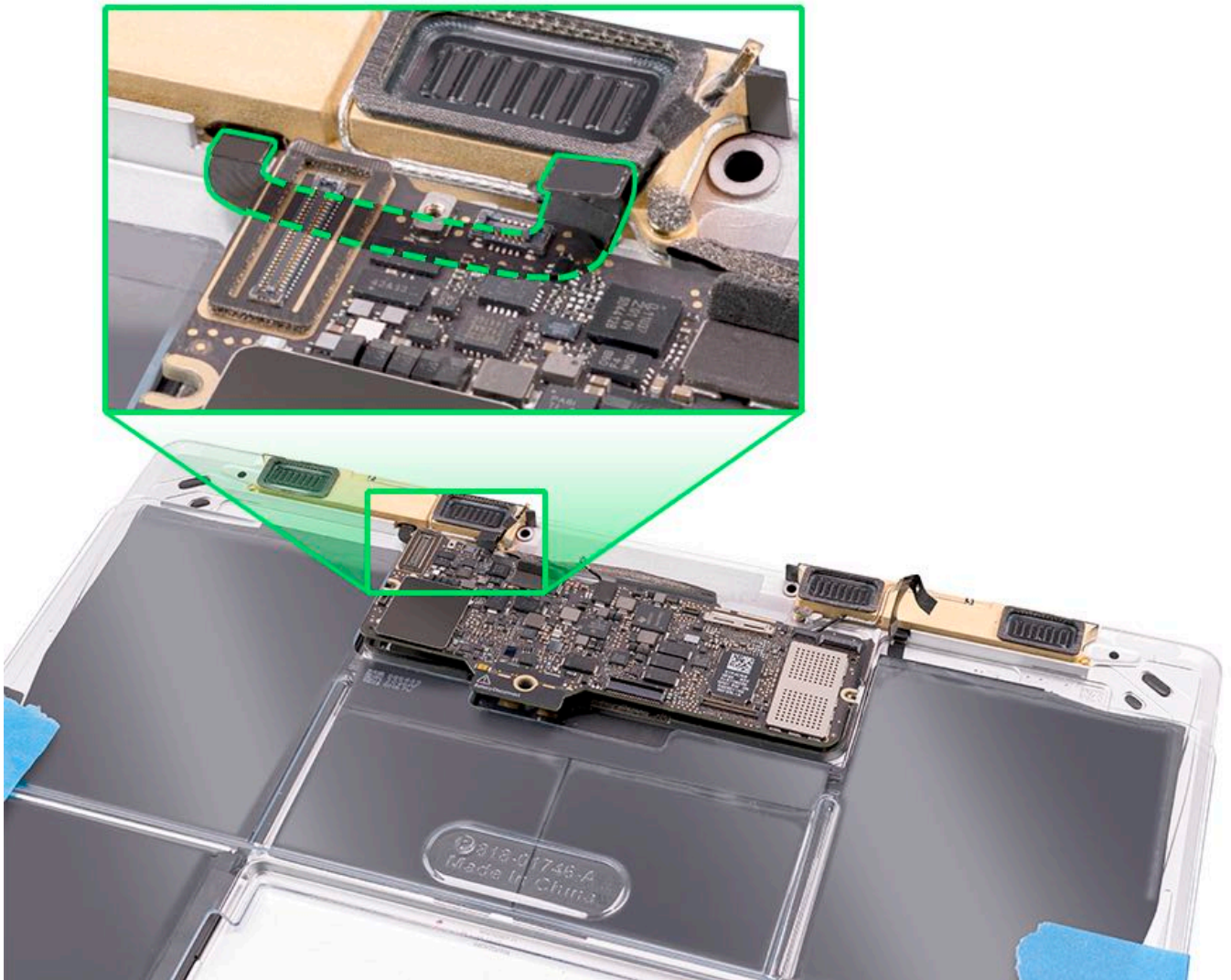


4. Use the pointed end of a black stick to hold the wireless antenna cables and the left speaker cable out of the way.



5. Gently place the logic board back into the bottom case. Ensure that the left speaker cable routes underneath the logic board.

Caution: Hold the logic board by the edges and do not touch the gold pins.



6. Reinstall two logic board screws. Reinstall the ground clip with the bottom screw.

- T5: 923-00419 (right)



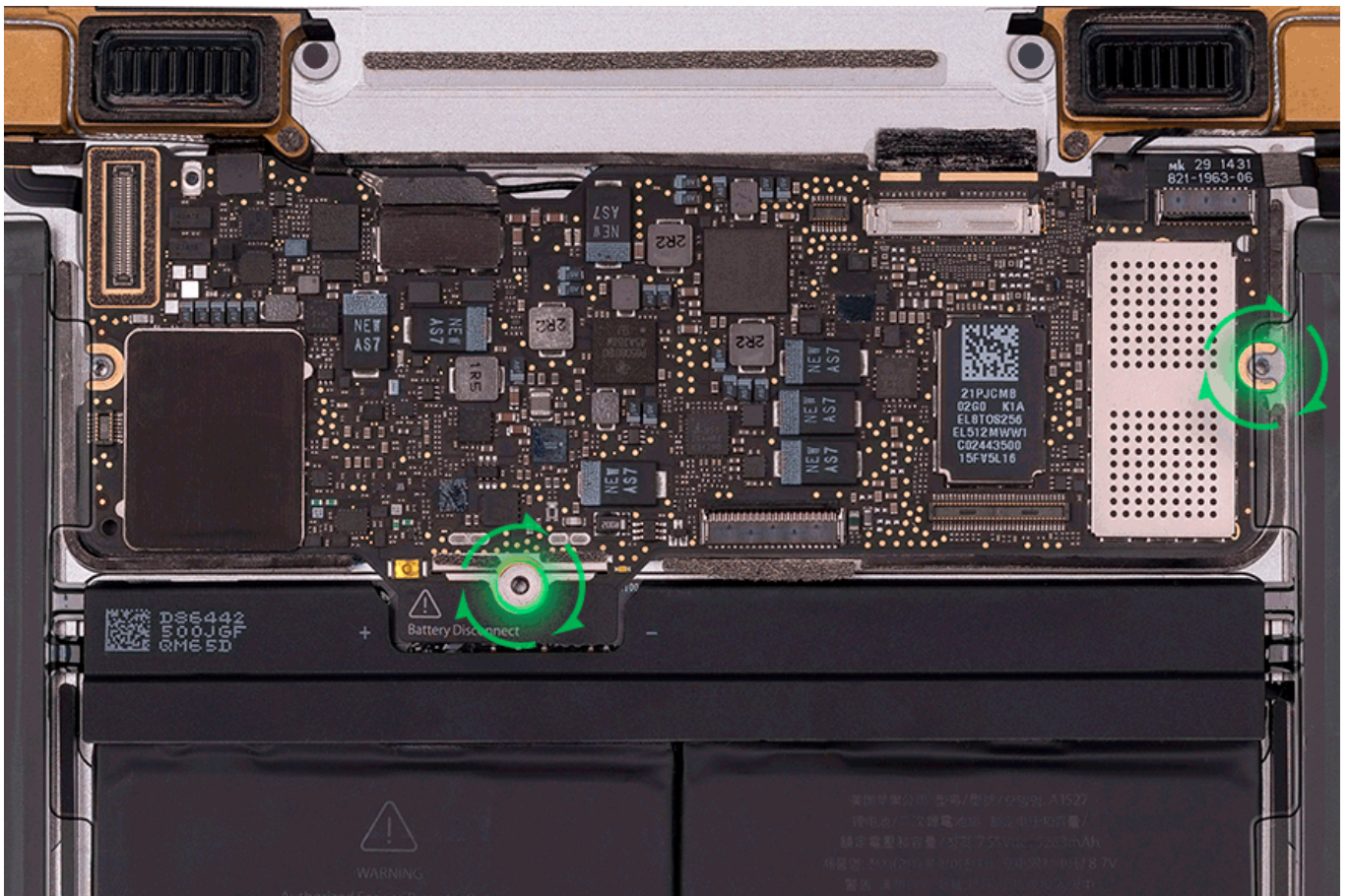
- T5: 923-00425 (bottom)



- Ground clip: 923-00470 (bottom, Early 2015 only)

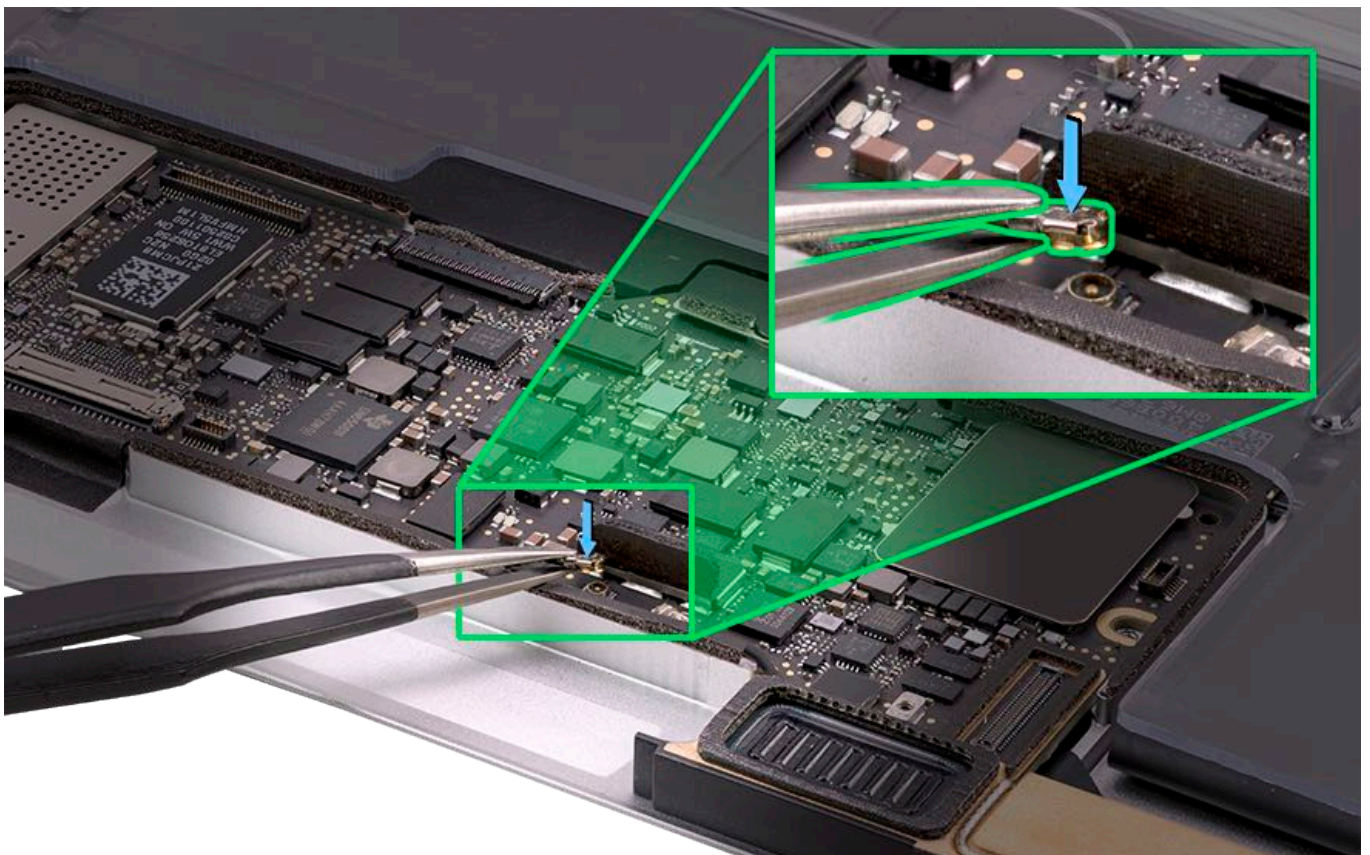


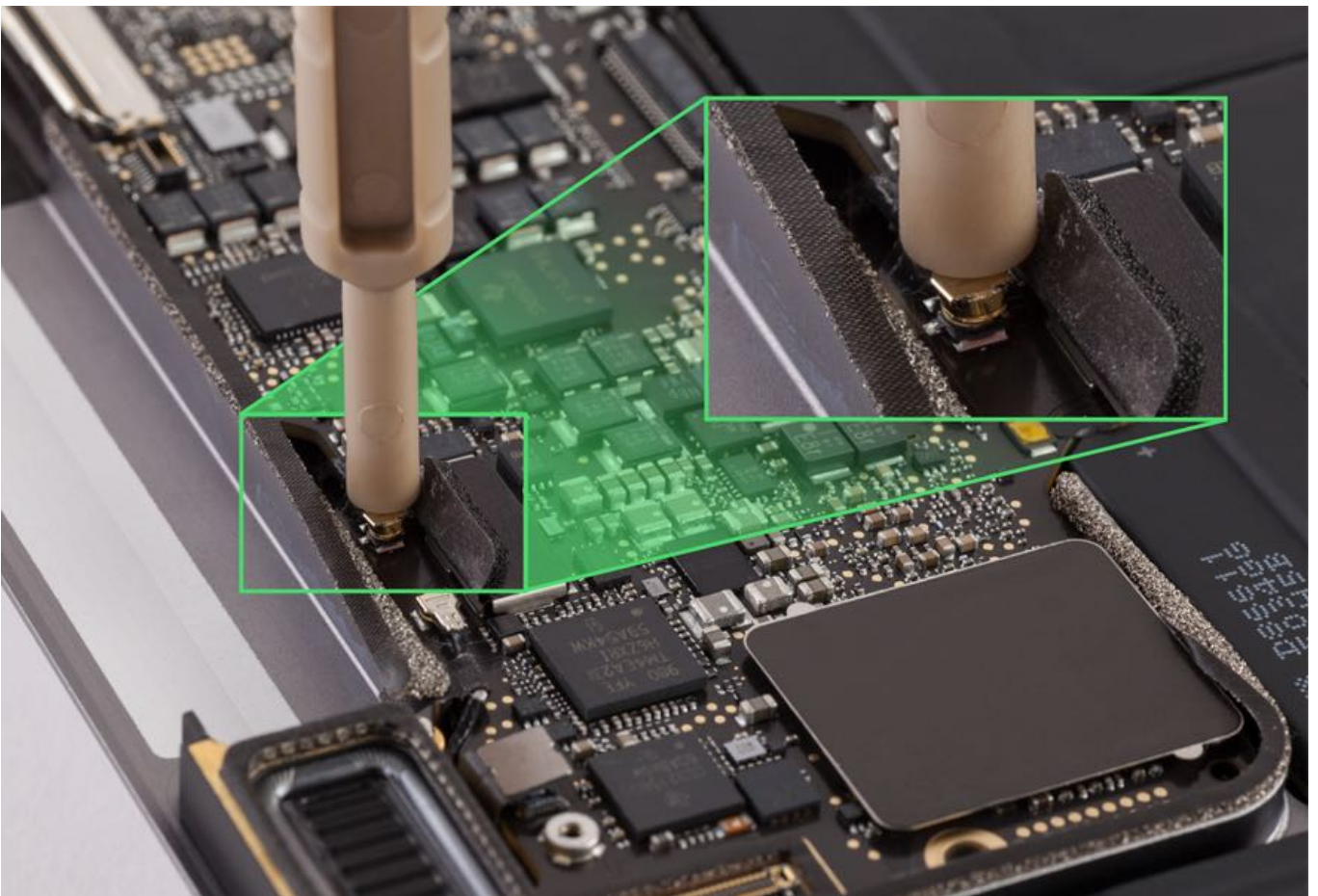
Note: Be sure the gaskets are still present on the ground clip. If the gaskets are not present, a new ground clip must be ordered.



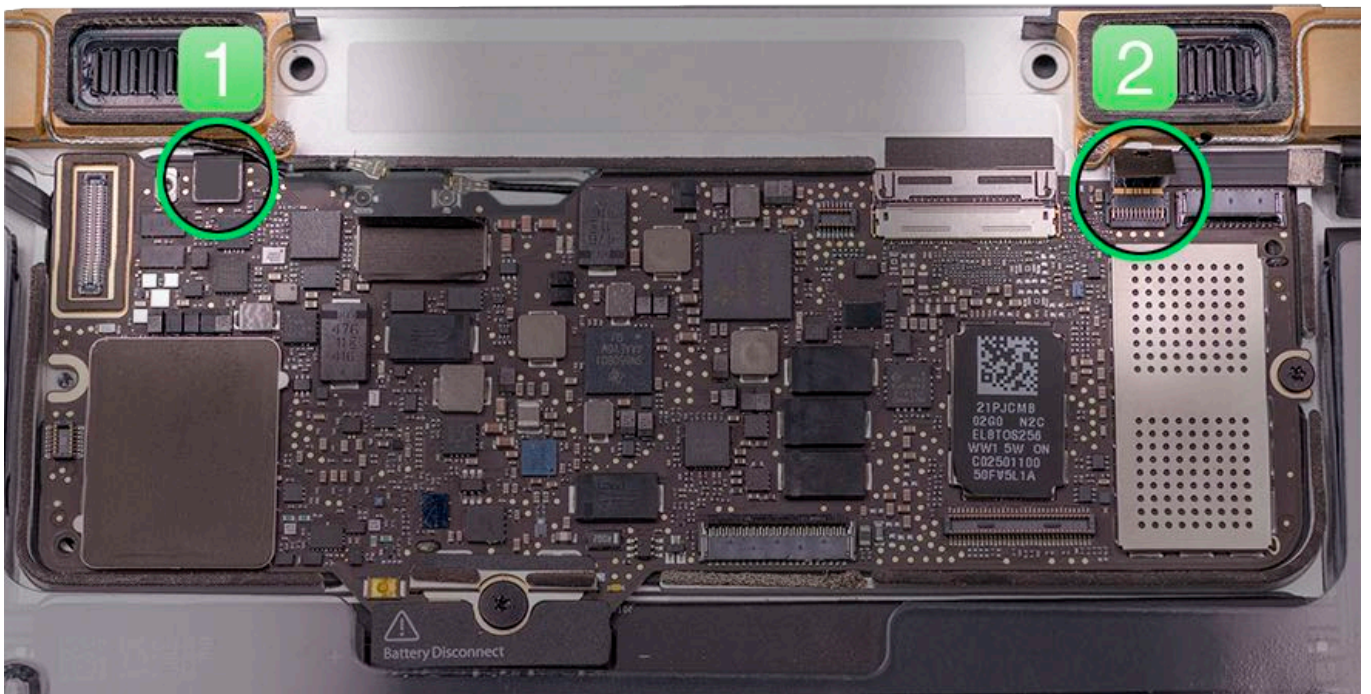
7. Use the flat-tip tweezers to reconnect the two wireless antenna cables and secure using the antenna tool.

Note: Be sure the cables are routed properly and connected securely. Replace the foam over the cable connectors. If foam is lost or damaged, replace with new foam that is included with replacement logic board.

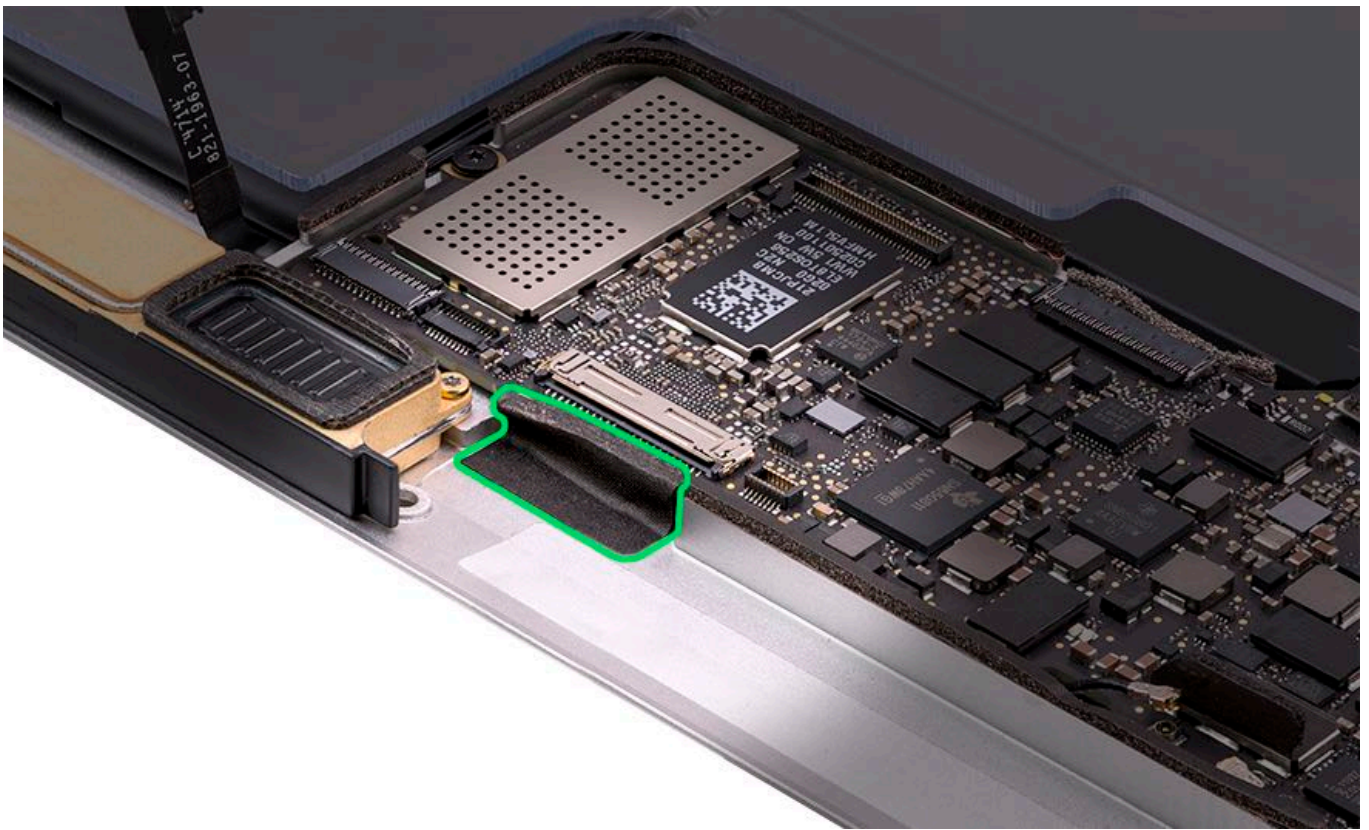




8. Reconnect the two speaker cables.



9. Install new EMI tape, included with the replacement part, to the logic board near the TCON connector.



10. Reinstall the [bottom case with battery](#).

11. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

12. If you have installed a replacement logic board, use Blank Board Serializer (BBS) to set the computer's serial number after the computer has been reassembled. BBS can be run from AST 2, or as a stand-alone, USB-based version found in article [SD63: Blank Board Serializer](#).

- For more information about AST and supported Mac models, see article [OP476: Latest Apple Service Toolkit download links and documentation](#).
- **Important:** When using BBS in AST 2, ensure that the unit under test (UUT) and the AST server are connected to the same network, and that the AST server has the latest software version installed.

13. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password via a feature such as Find My Mac or FileVault. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data.

1. Choose Apple menu > Restart, then hold down the Command (⌘) and R keys while the computer restarts.
Note: To force OS X Lion or later, or macOS Sierra, into Internet Recovery, press and hold the Command-Option-R key combination while starting up the computer.
2. If the computer is not connected to the Internet, choose a network from the Wi-Fi menu (in the top-right corner of the screen).
3. Select "Reinstall OS X" (or macOS), then click Continue.
4. Follow the onscreen instructions. In the pane where you select a disk, select your current OS X or macOS disk (in most cases, it is the only one available).
5. To start the installation, click Install.

Check for and apply the latest software and firmware updates.

For more information, refer to article [HT201314: About macOS Recovery](#).

Speaker/Antenna Modules

First Steps

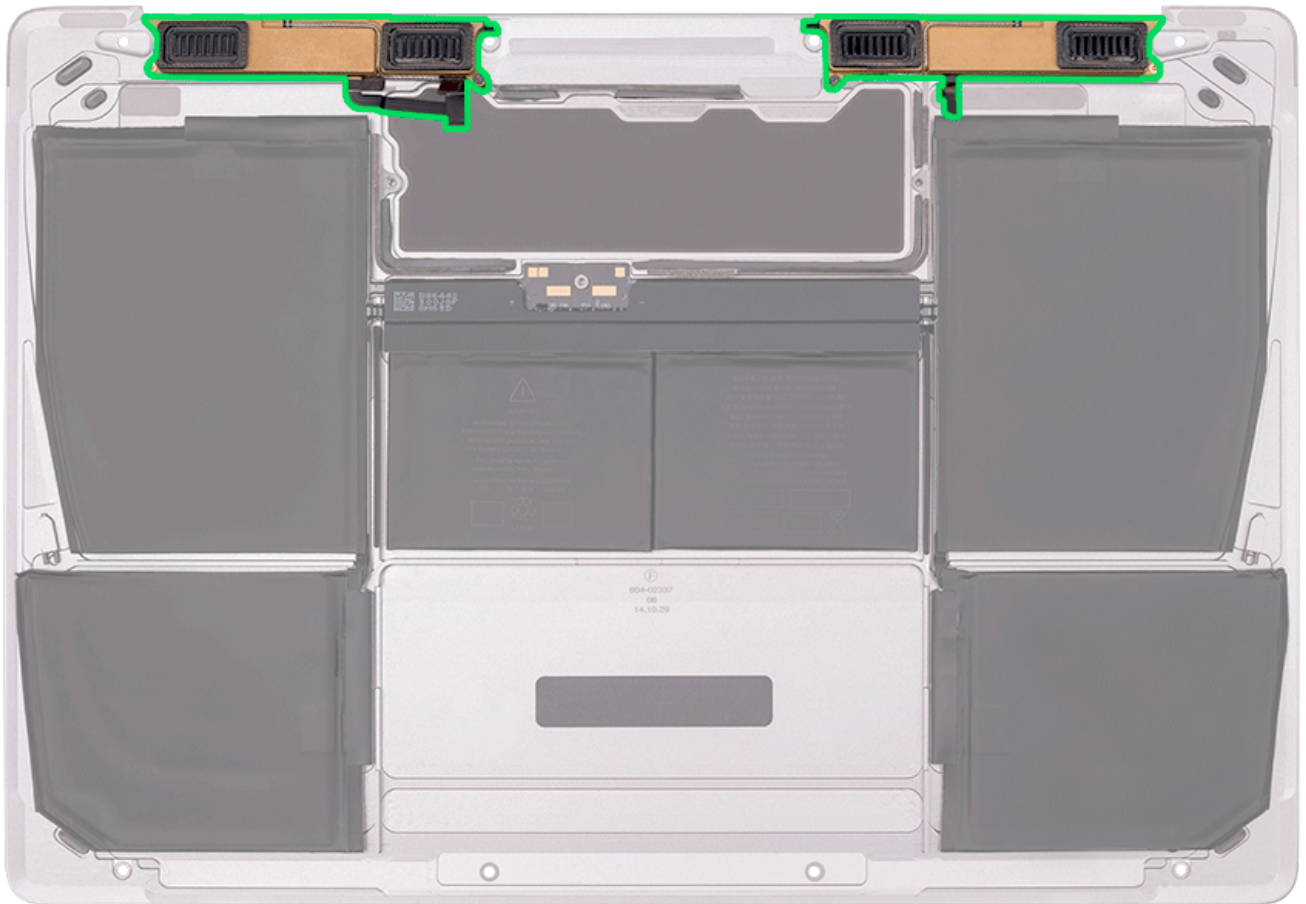
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

For video instruction, refer to article [SV277: Speaker/Antenna Modules Replacement Video](#).

Remove:

- [Bottom case with battery](#)
- [Logic board](#)



Tools

- ESD wrist strap
- Black stick
- ESD-safe plastic or nylon tweezers
- Torx T3 screwdriver
- Isopropyl alcohol (IPA) wipes



Steps For Removal

Important: The speaker/antenna modules must be replaced as a pair.

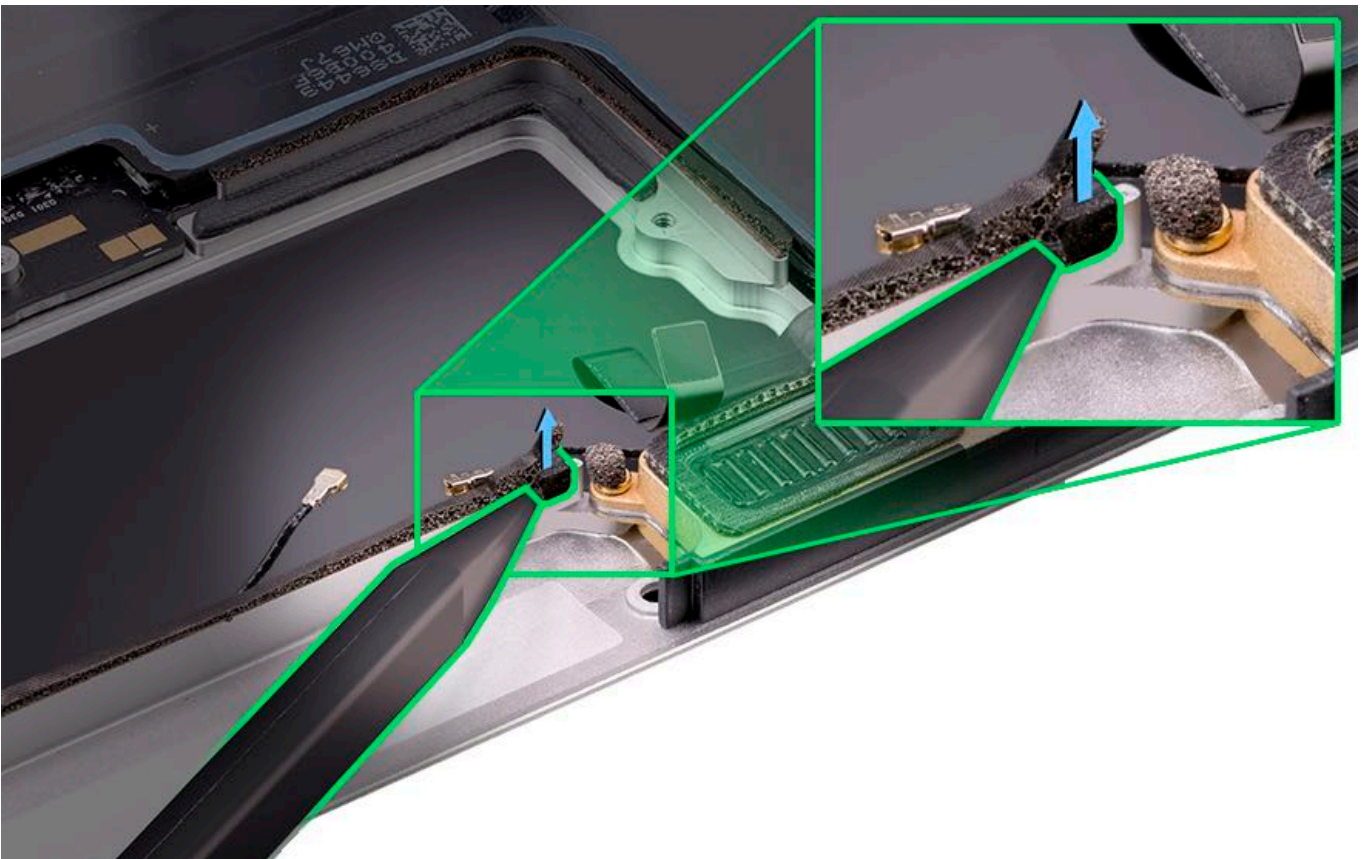
1. **Early 2015 only:** Use the flat end of a black stick to peel back about one-quarter inch of the logic board frame padding from the logic board wall.

Note: There is no need to peel back the logic board frame padding on MacBook (Retina, 12-inch, Early 2016 and 2017).



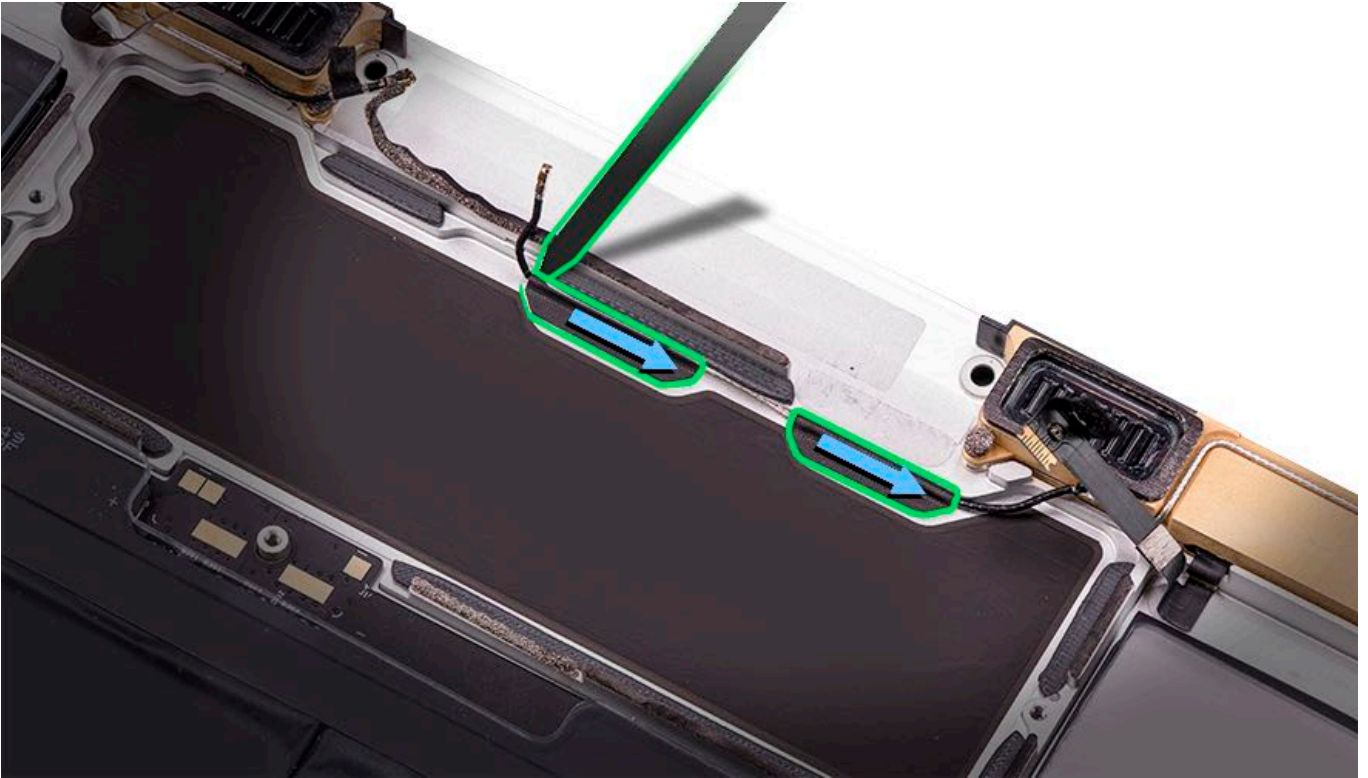
2. With the pointed end of a black stick, gently peel away the EMI tape that holds the left wireless antenna cable to the logic board frame.

Note: Only MacBook (Retina, 12-inch, Early 2015) has the foam gaskets pictured below.



3. Use the pointed end of a black stick to peel two strips of black EMI tape from the bottom case.

Caution: Avoid touching the thermal material on the bottom case.



4. Remove four screws from the speaker/antenna modules.

- T3: 923-00420

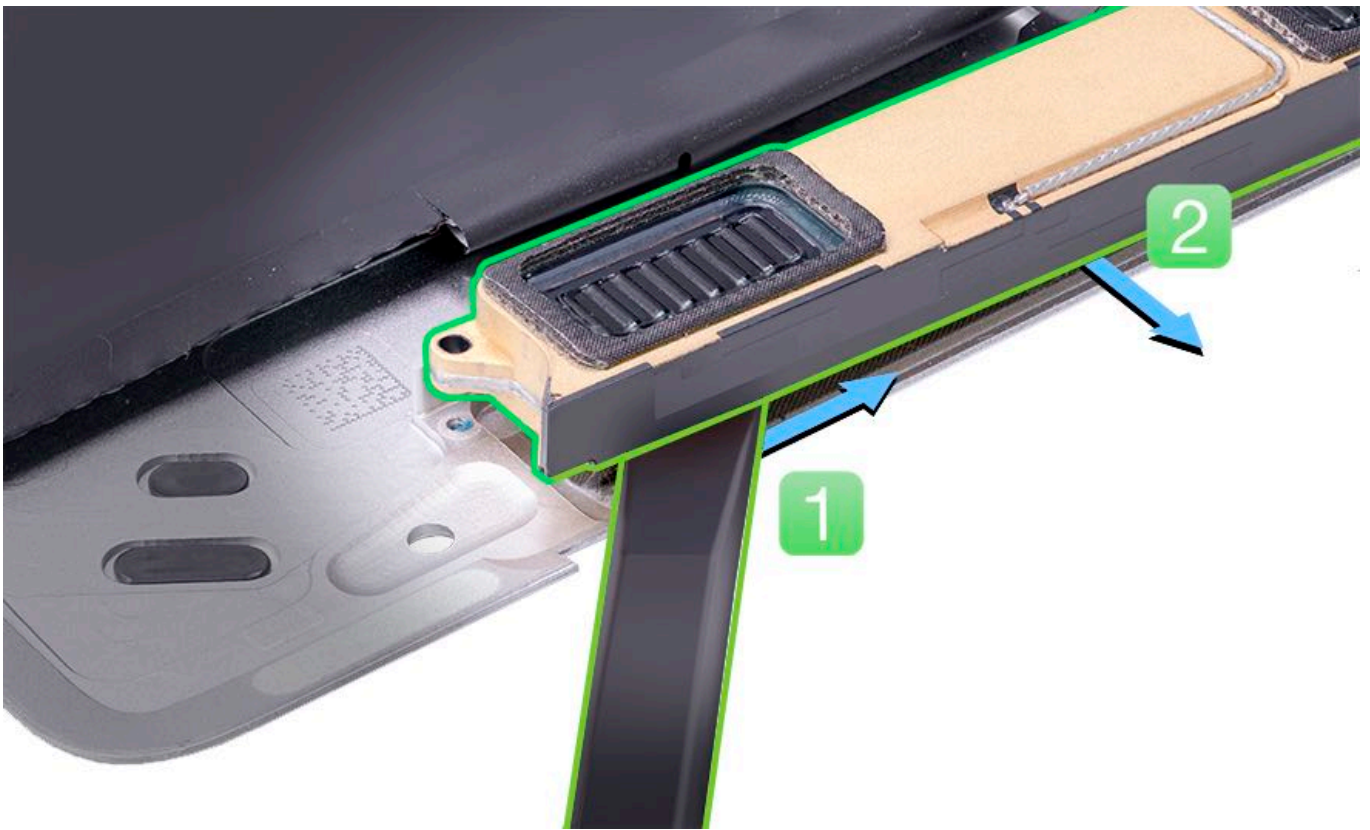


Note (Early 2015 only): The inner screws have one-time-use foam gaskets on them. Remove the gaskets with ESD-safe tweezers before removing the screws. New foam is included with the replacement parts.



5. Use the flat end of a black stick to carefully loosen the adhesive that attaches the speaker/antenna modules to the bottom case (1).

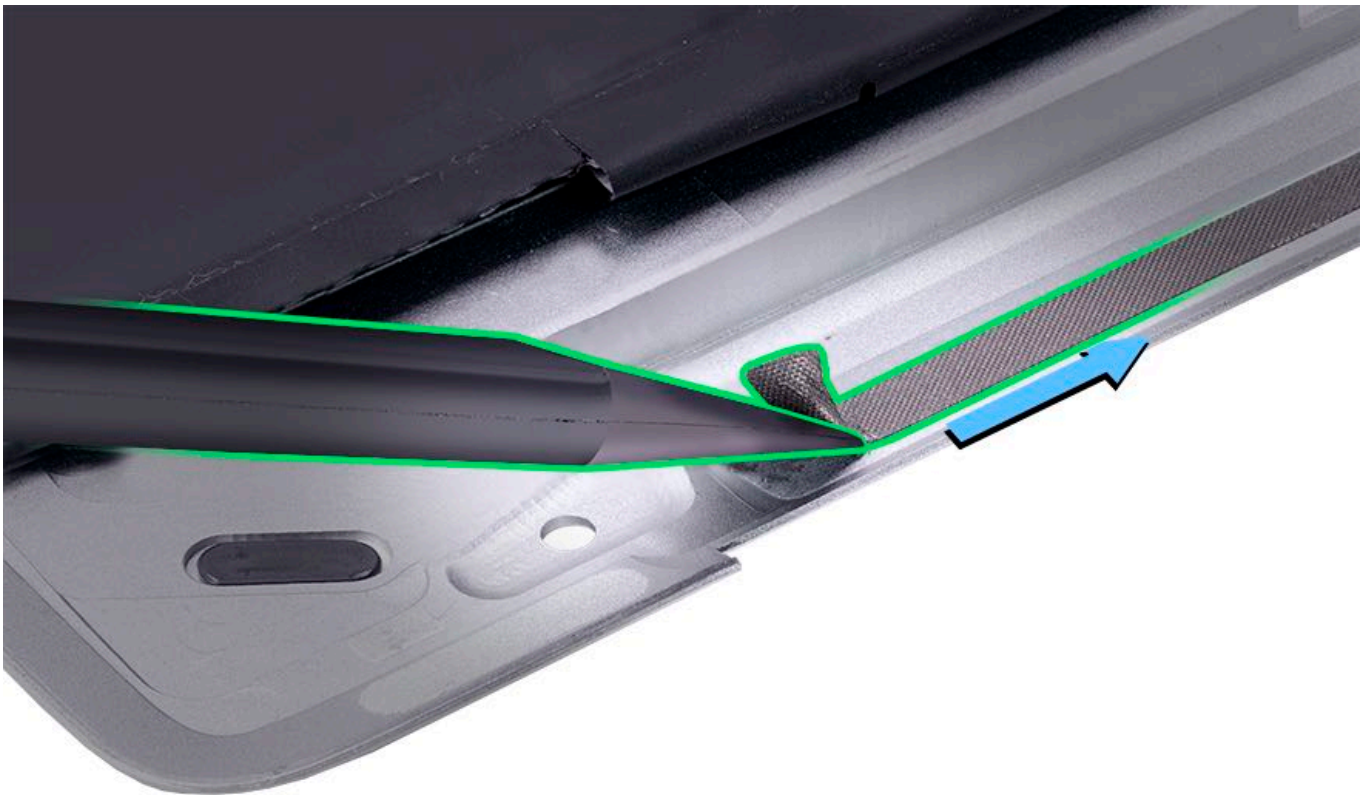
6. Gently remove the speaker/antenna modules (2).



Steps For Reassembly

Important: Speaker/antenna modules must be replaced as a pair.

1. Before replacing the speaker/antenna modules, remove the adhesive from the bottom case with a black stick and clean the area with IPA wipes.



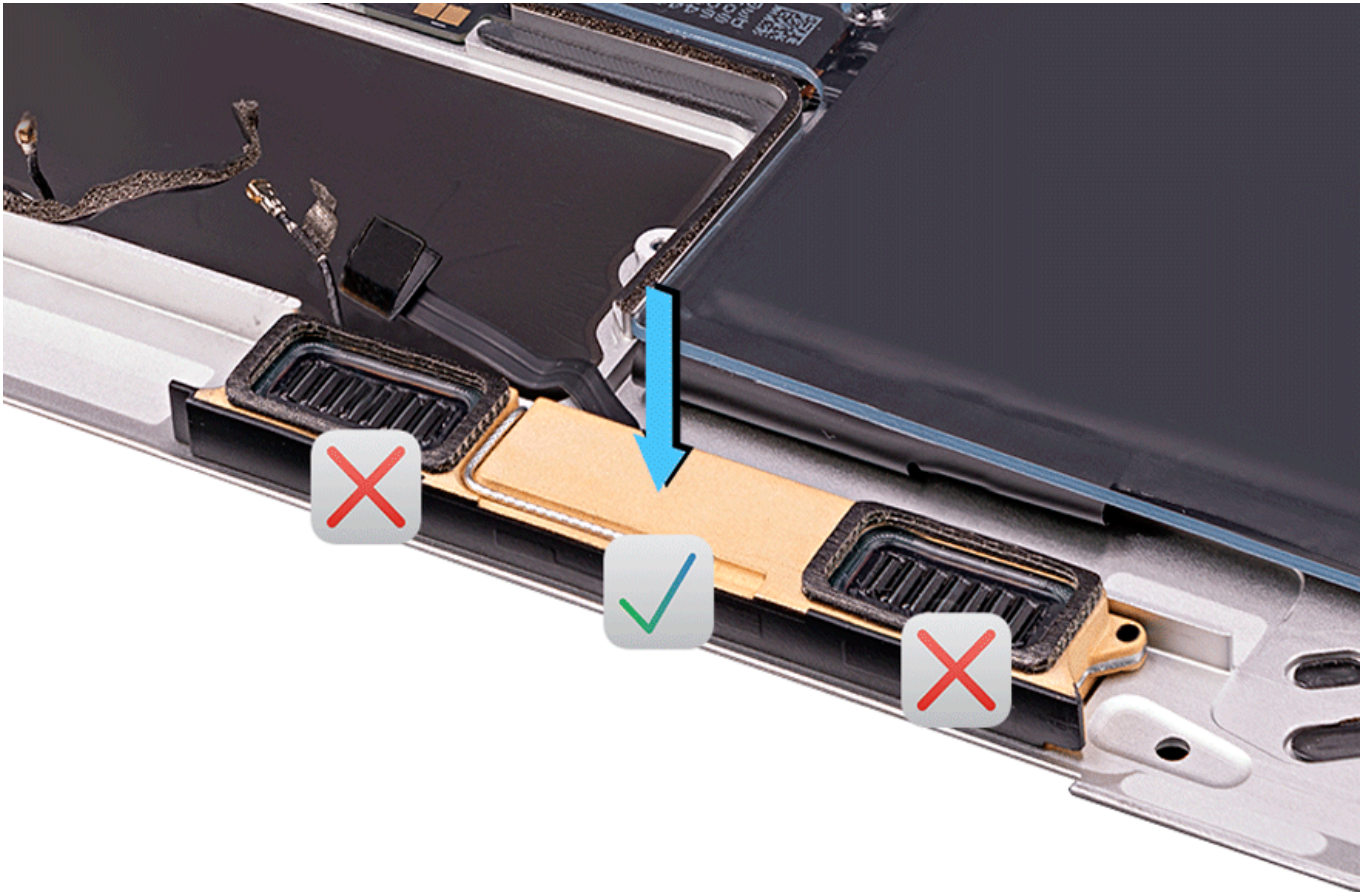
2. Apply the new adhesive strips, included with the replacement part, to the section of the bottom case that is not anodized.

3. Once the adhesive is applied to the bottom case, remove the backing from the adhesive strip.

4. Align the screw holes to set the speaker/antenna modules into place.

5. Gently press the speaker/antenna modules into place. Press down for approximately three seconds.

Caution: Do not touch the speaker cones.

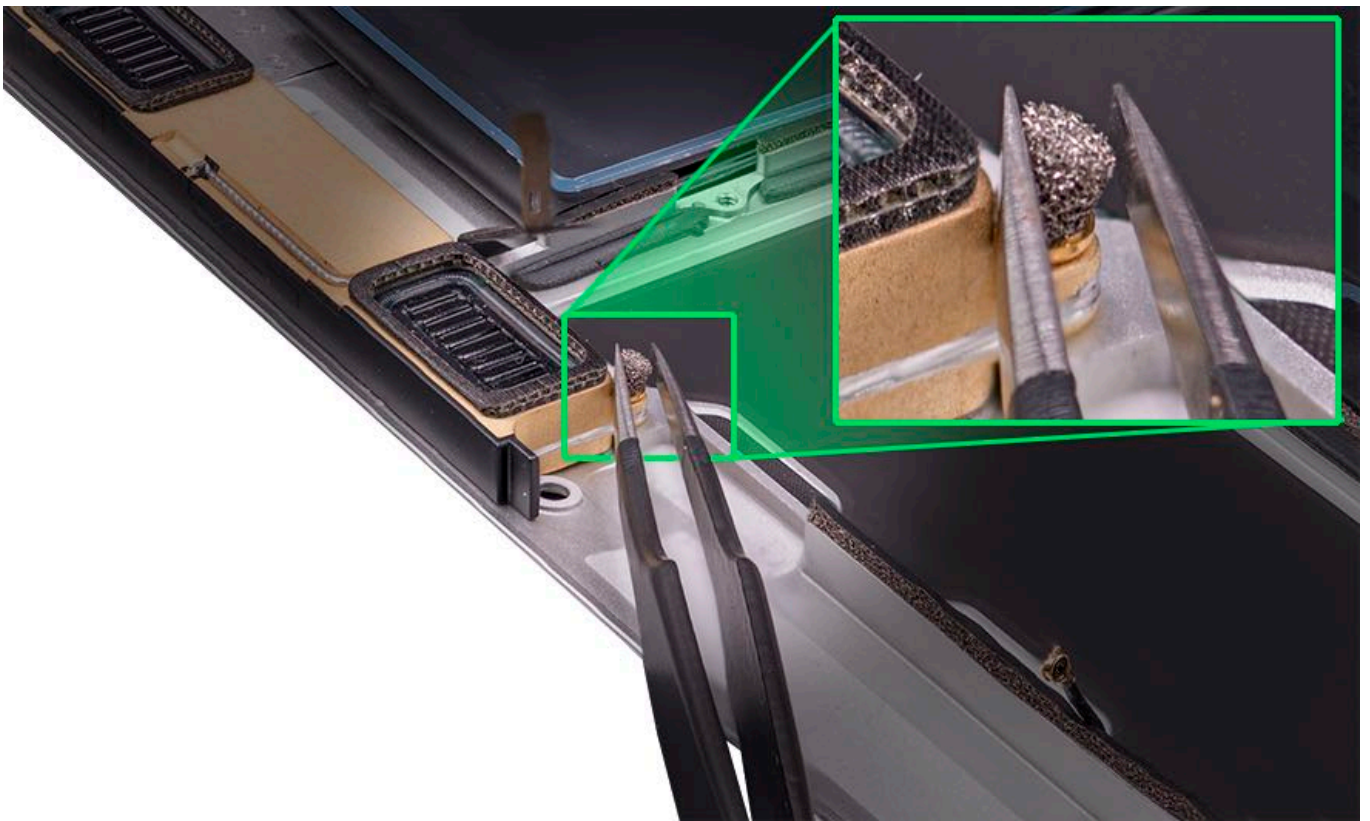


6. Reinstall the four screws to the speaker/antenna modules.

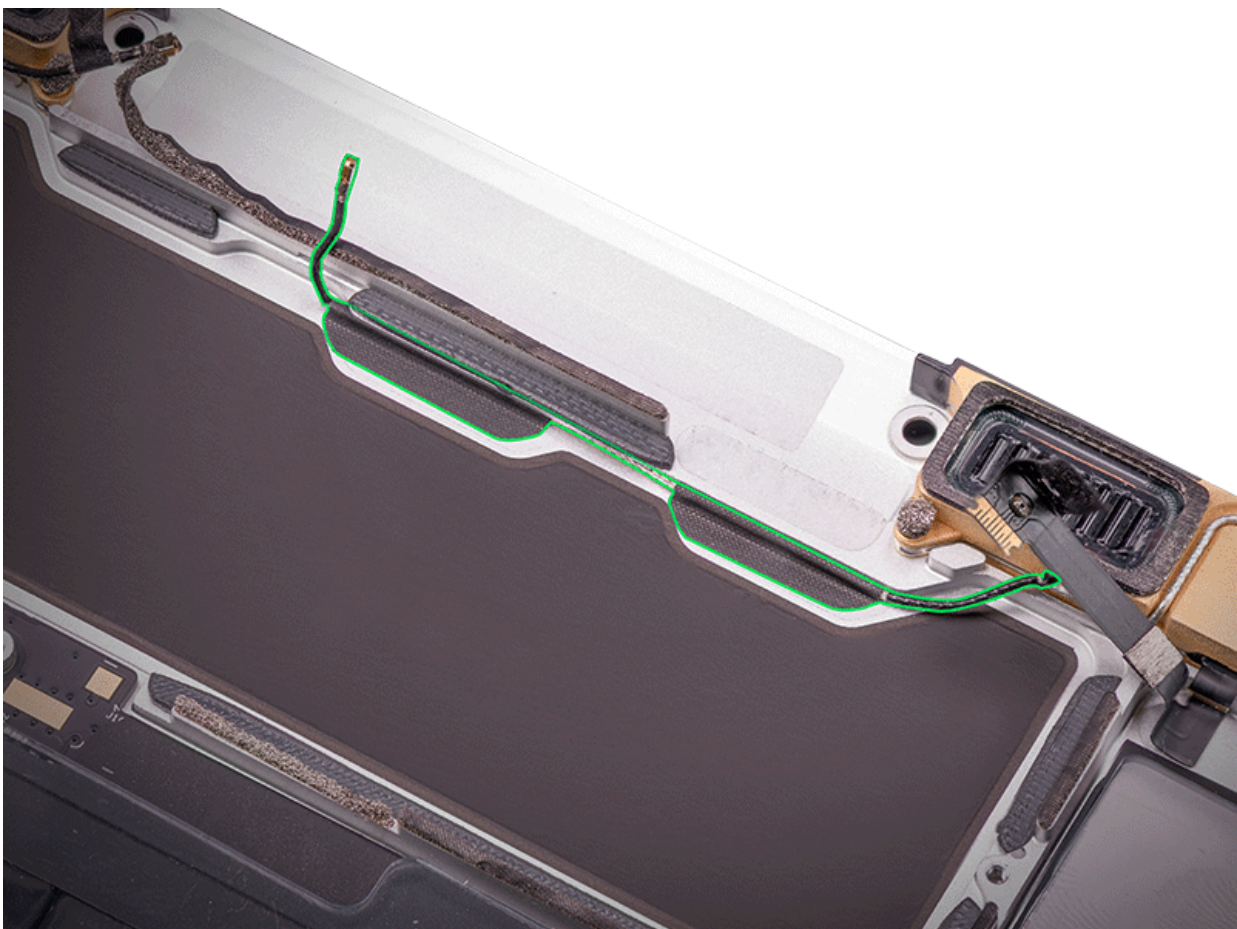
- T3: 923-00420



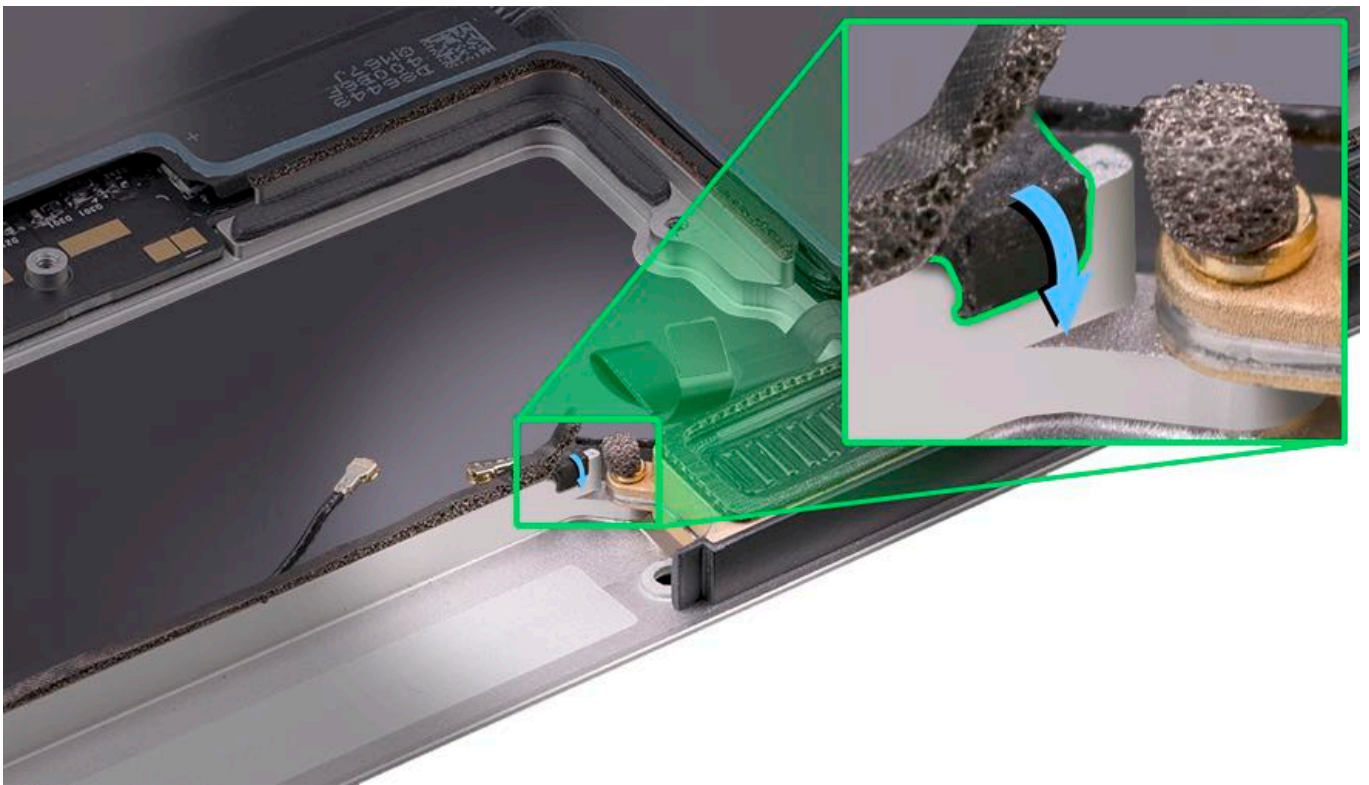
7. **Early 2015 only:** Use ESD-safe tweezers to adhere the new foam gaskets, included with the replacement part, to the two inner screws.



8. Align the wireless cable against the rib frame of the bottom case. Hold the cable in place while using the flat end of a black stick to press the tape onto the bottom case.



9. Reinstall the EMI tape that secures the left wireless antenna cable to the bottom case.



10. Reinstall the [logic board](#).
11. Reinstall the [bottom case with battery](#).
12. The Speaker Equalization Reset, found in AST 2, must be run after the speaker/antenna modules are replaced.
13. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
14. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Audio Board

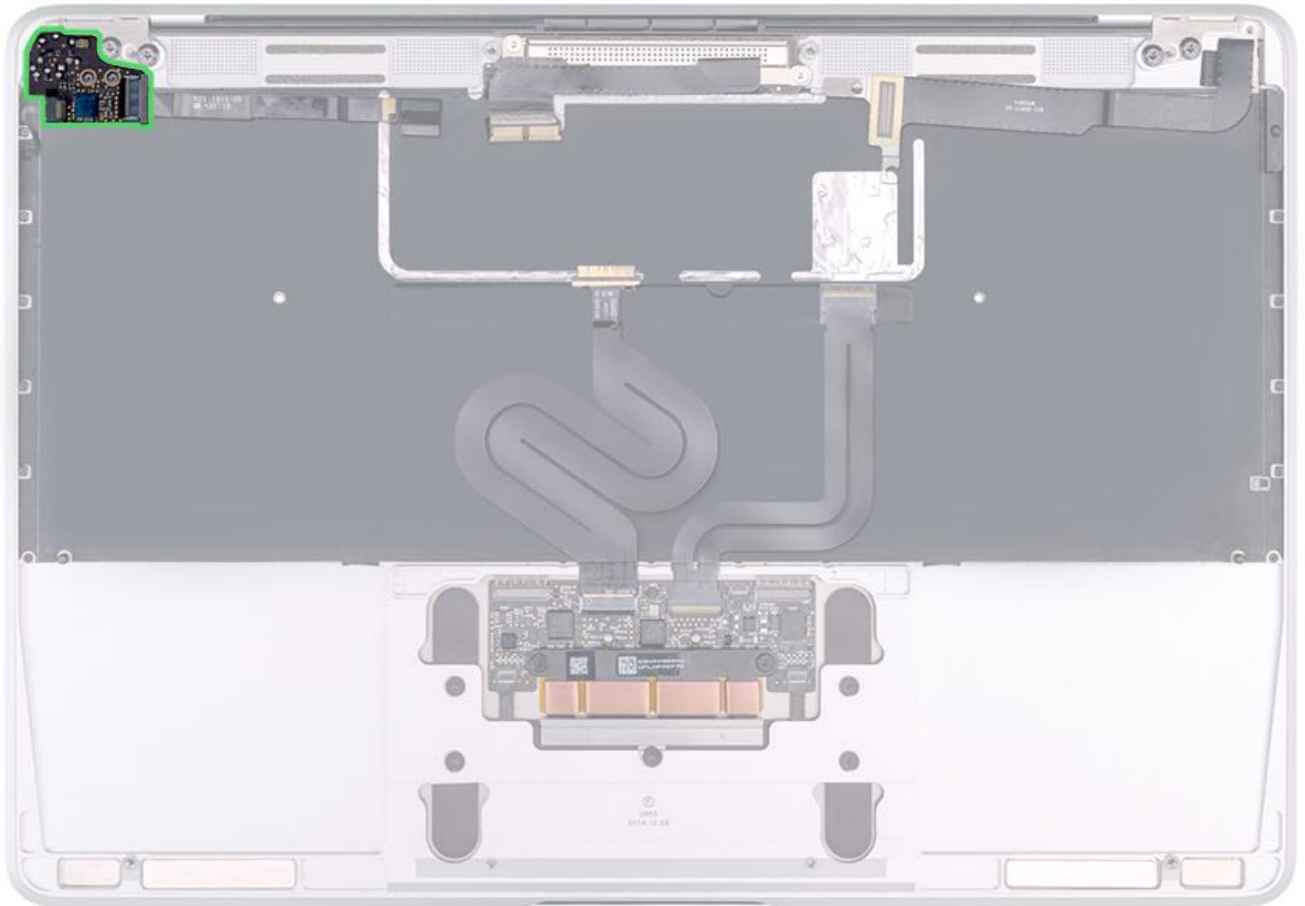
First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)



Tools

- ESD wrist strap
- Black stick
- Torx T5 screwdriver



Steps For Removal

1. Lift the locking lever and carefully disconnect the microphone cable.

Caution: Be careful when disconnecting the microphone cable. If the microphone cable is damaged, the top case will need to be replaced.

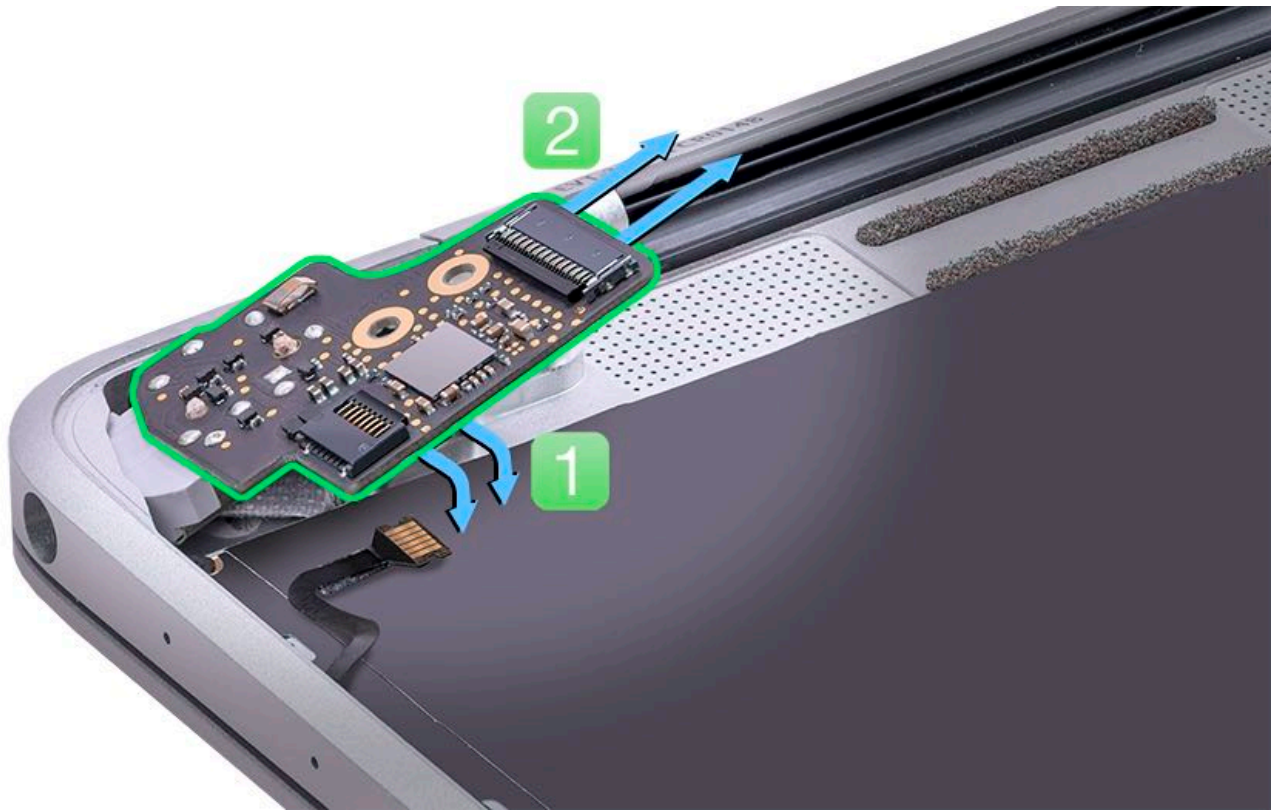


2. Remove two screws from the audio board.

- T5: 923-00421



3. Slightly tilt the audio board down as shown (1), then slide it to the side and remove it (2).



Steps For Reassembly

1. Reassemble in reverse order of the removal steps.
2. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
3. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Display Assembly

First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

For video instruction, refer to article [SV278: Display Assembly Replacement Video](#).

Remove:

- [Bottom case with battery](#)
- [Audio board flex cable](#)
- [Audio board](#)
- [I/O board and flex cable assembly](#) (Early 2016 and 2017 only)



Tools

- ESD wrist strap
- Black stick
- Torx T5 screwdriver
- Torx T8 screwdriver
- Clean, soft, lint-free cloth



Steps For Removal

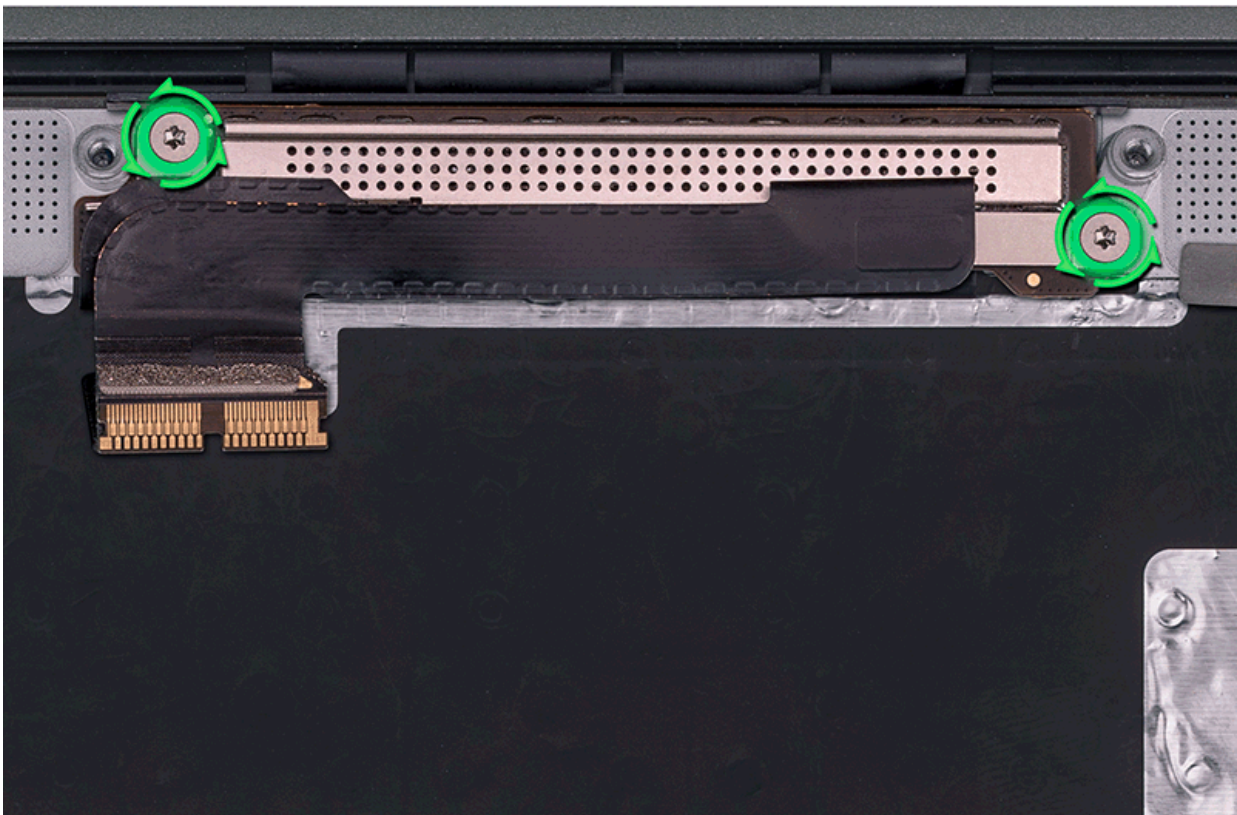
1. Remove two screws from the timing controller (TCON) board.

- T5: 923-00455



Caution:

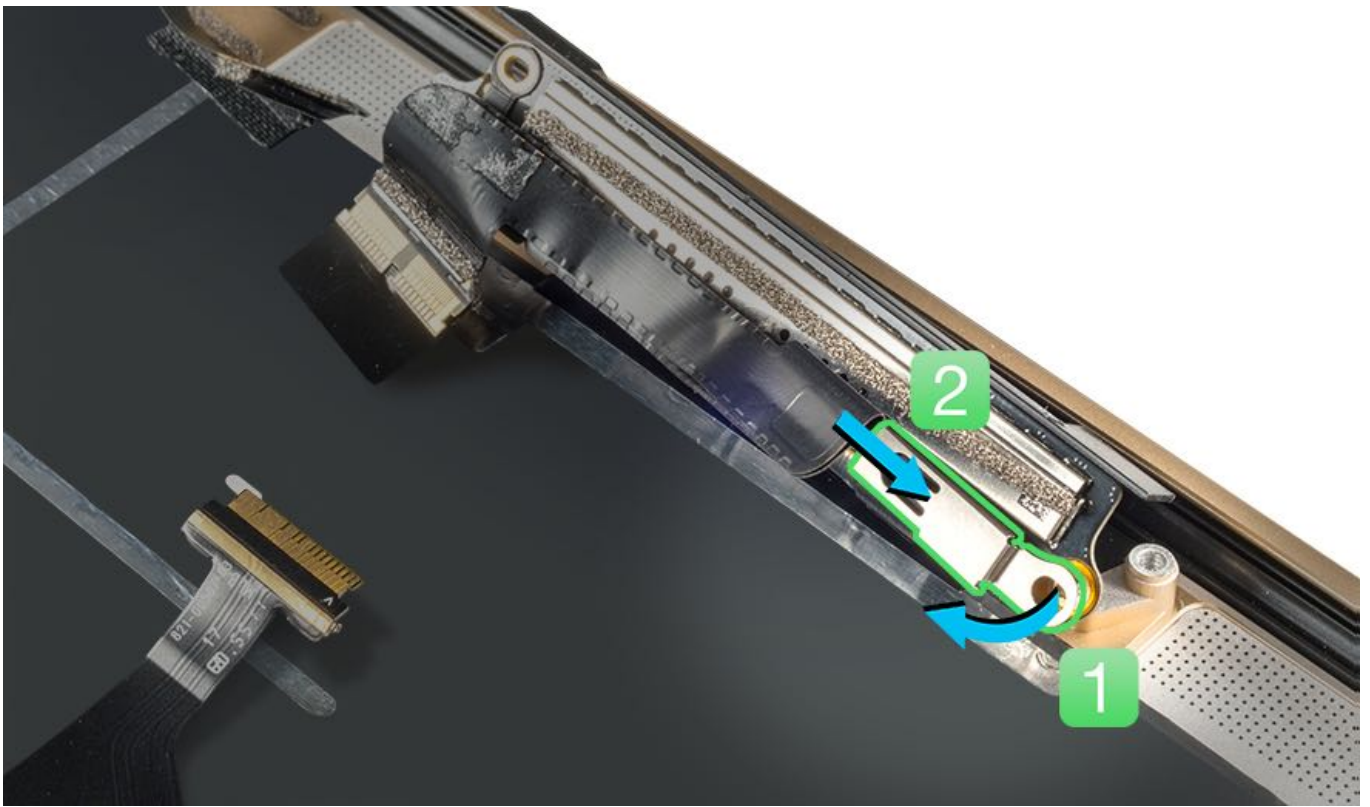
- Do not attempt to remove the display assembly without removing the TCON board screws.
- Do not attempt to separate the TCON board from the display.
- The TCON flex cable is fragile and requires delicate handling. Ensure that it retains its shape and is not bent, pulled, or pinched during service.



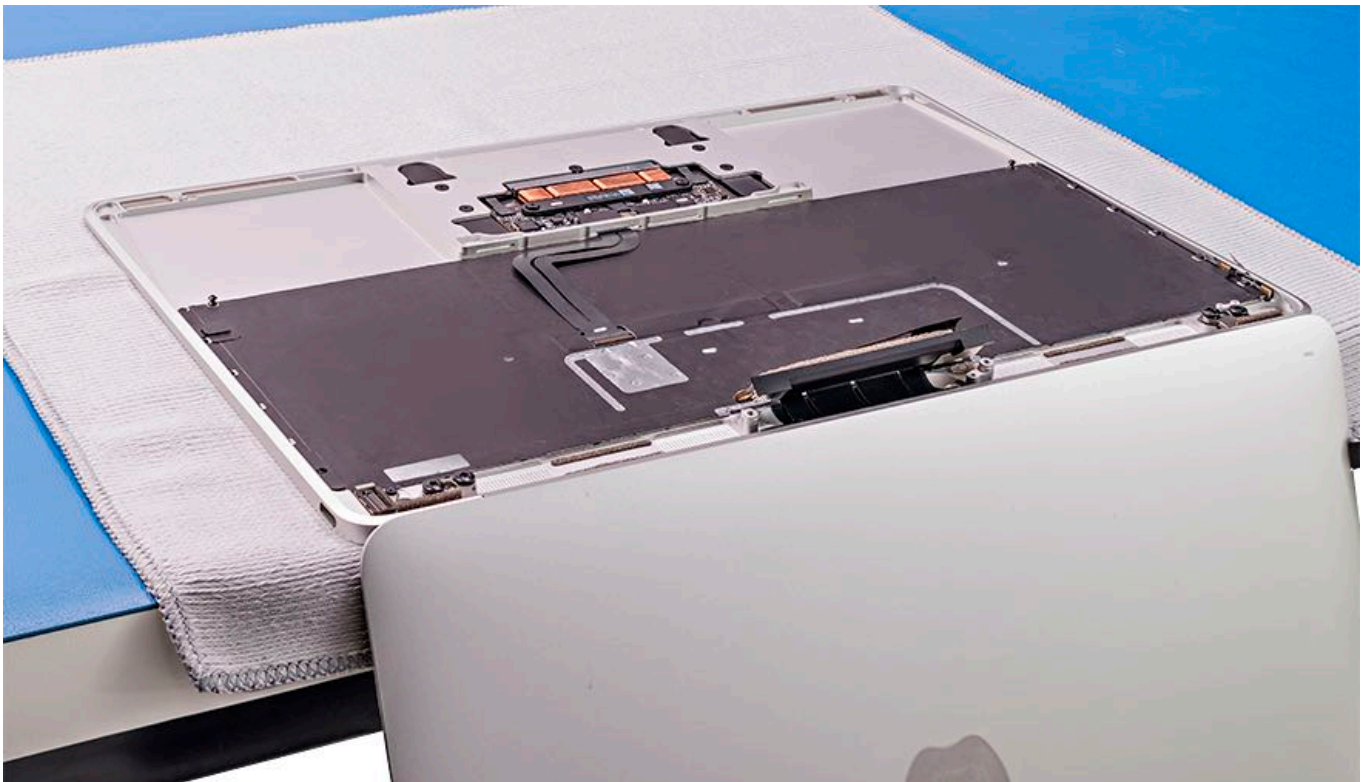
2. Tilt the cowling upwards (1), then unhook it and gently slide it out (2). If the cowling is intact, reuse it when reassembling the computer.

Note: The TCON cable cowling is pre-installed on the Early 2016 and 2017 models. The TCON cable cowling is shipped with replacement displays for the Early 2015 model. If the cowling on the 2015 model is bent or damaged, order a new one (923-01002).

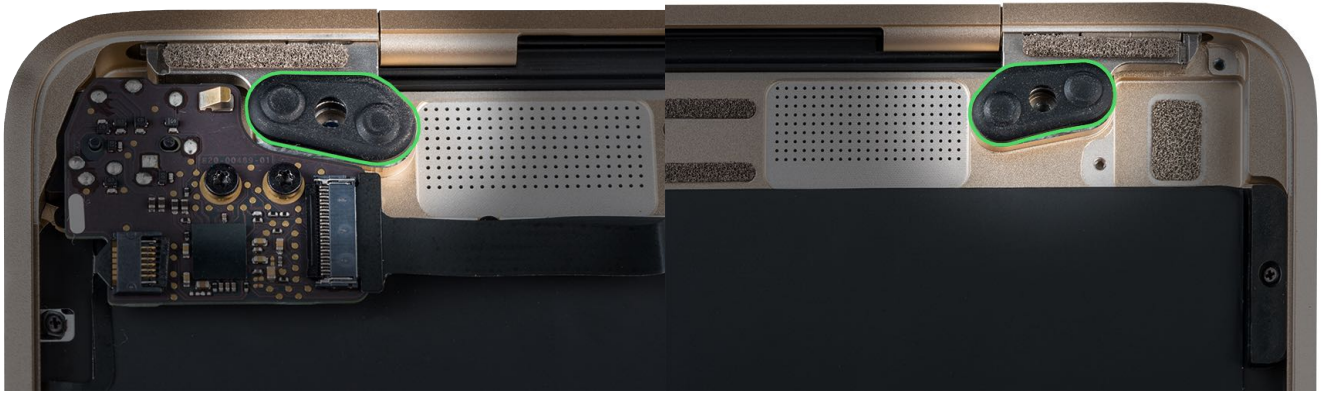




3. Extend the display to 90 degrees. Lay the computer over the edge of the bench as shown.

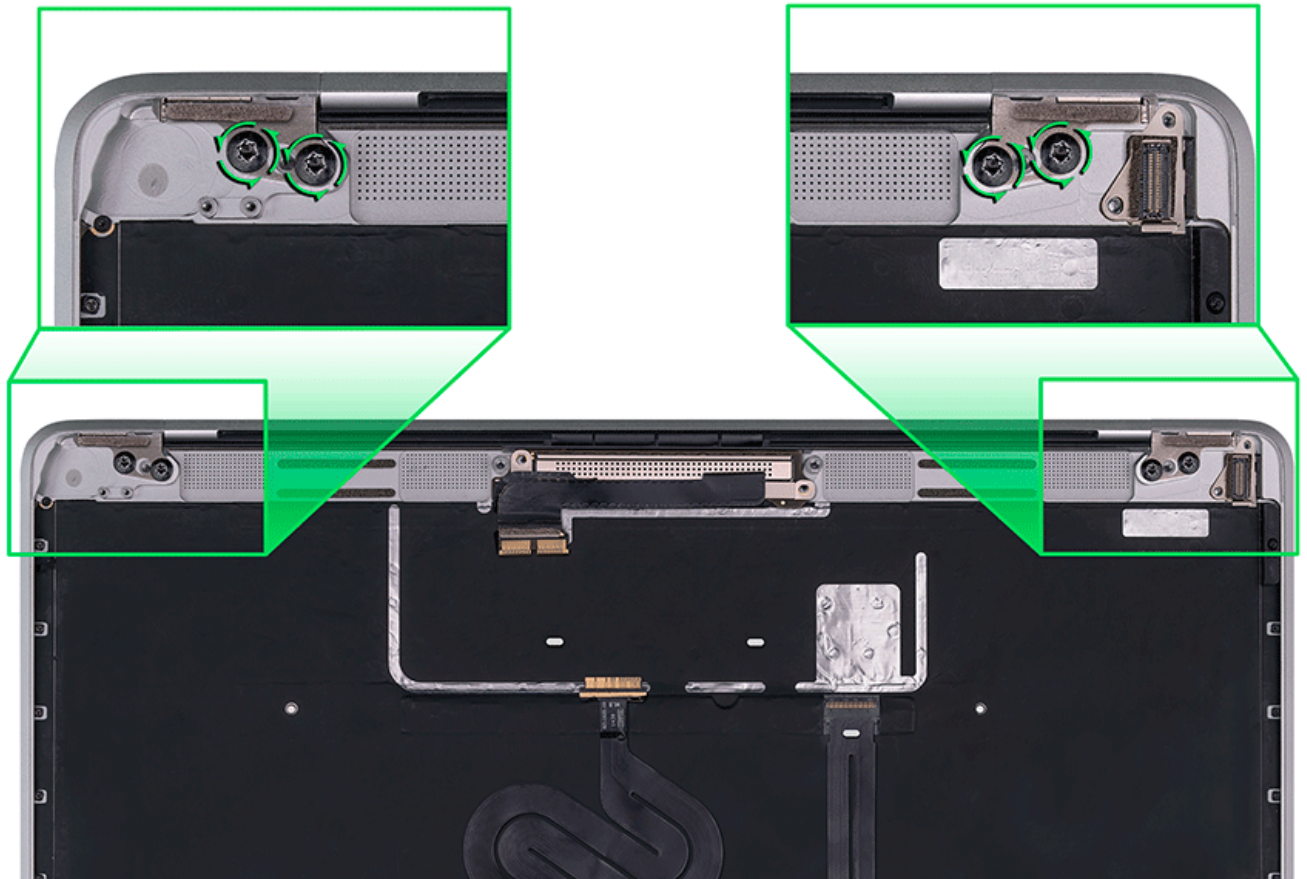


Important: Early 2016 and 2017 models have clutch covers that need to be removed when removing the display. The covers are attached lightly with adhesive. Lift them off with the pointed end of a black stick or use your fingers and then discard them. New clutch covers are included with the replacement display.



4. Remove two screws from each display hinge.

- T8: 923-00426

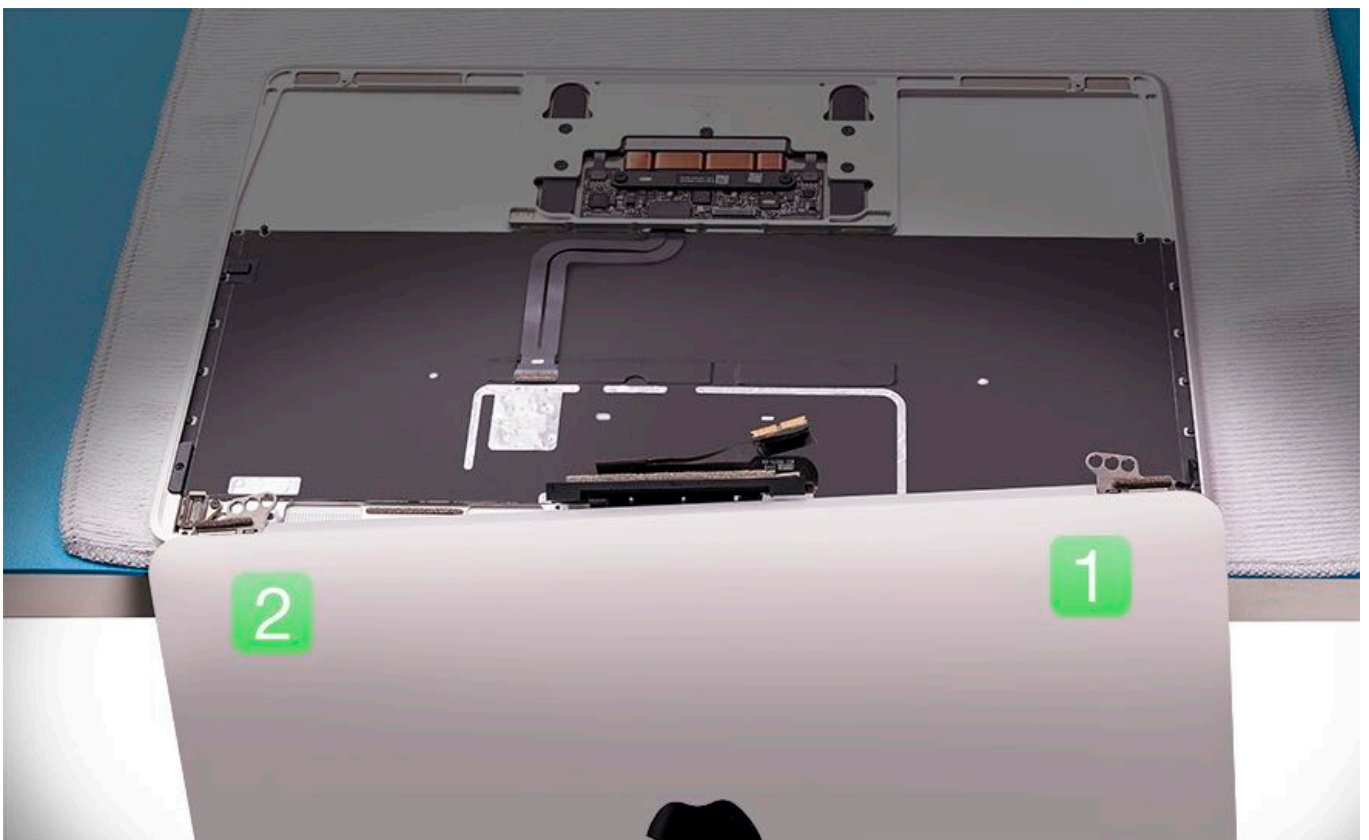


Caution: In the next step, if the display is moved too far to the right, the cables that attach the TCON board to the display (2) can be damaged by the TCON screw standoff (1). When removing the display, move it only about 1 mm and no more than 1 cm. If the TCON board or its cables are damaged, the entire display must be replaced.



5. Remove the display from the top case using all of the following steps:

- Hold both sides of the display.
- Extend the display fully.
- Push the right hinge (1) forward to lift that hinge up and out of the top case.
- Keep the right corner of the display low and close to the top case.
- Move the display approximately 1 mm to the right.
- Push the left hinge (2) forward to lift that hinge up and out of the top case.
- With both hinges free, lift the display straight up from the top case.



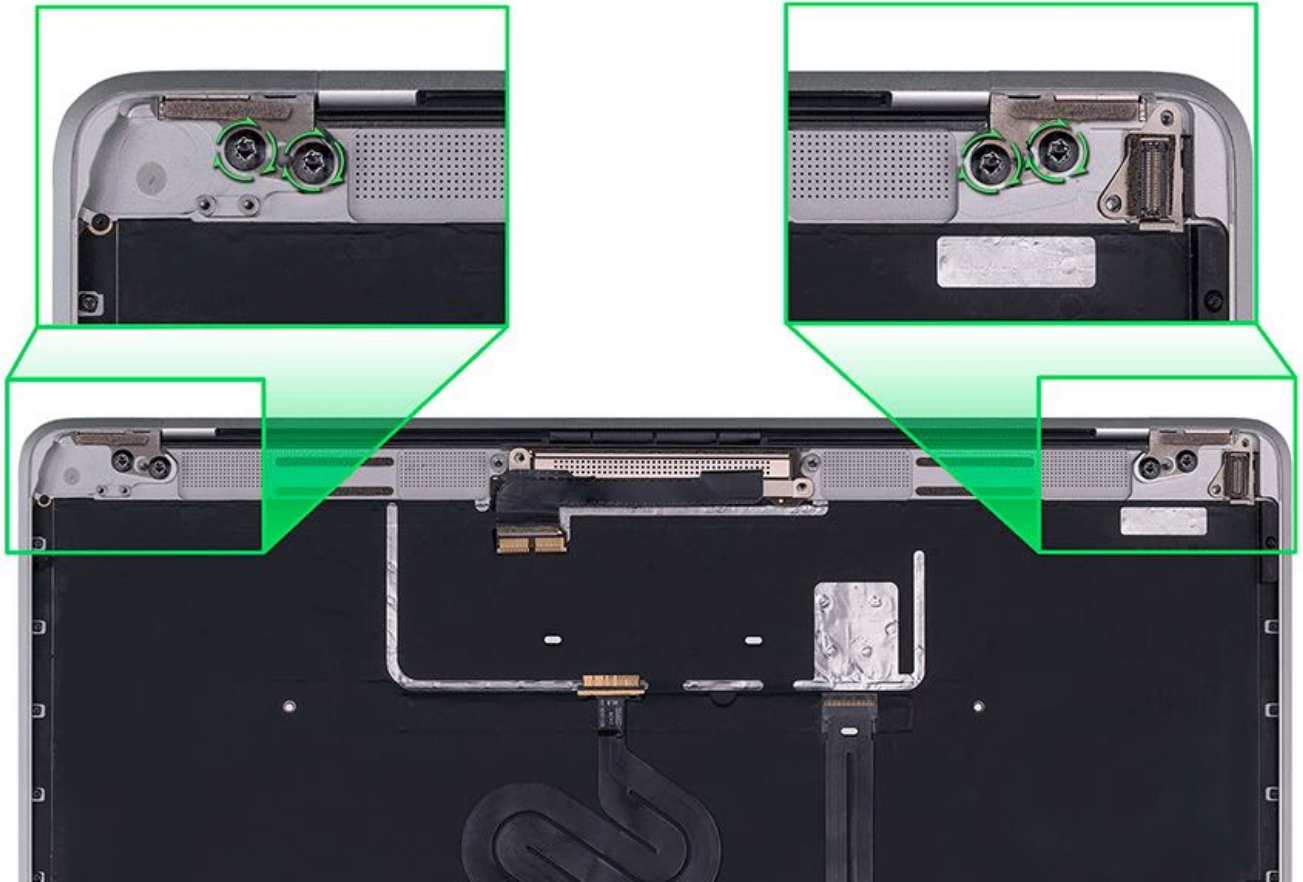
Steps For Reassembly

1. Reassemble and align the display assembly.

- Loosely install the four clutch screws.
 - T8: 923-00426



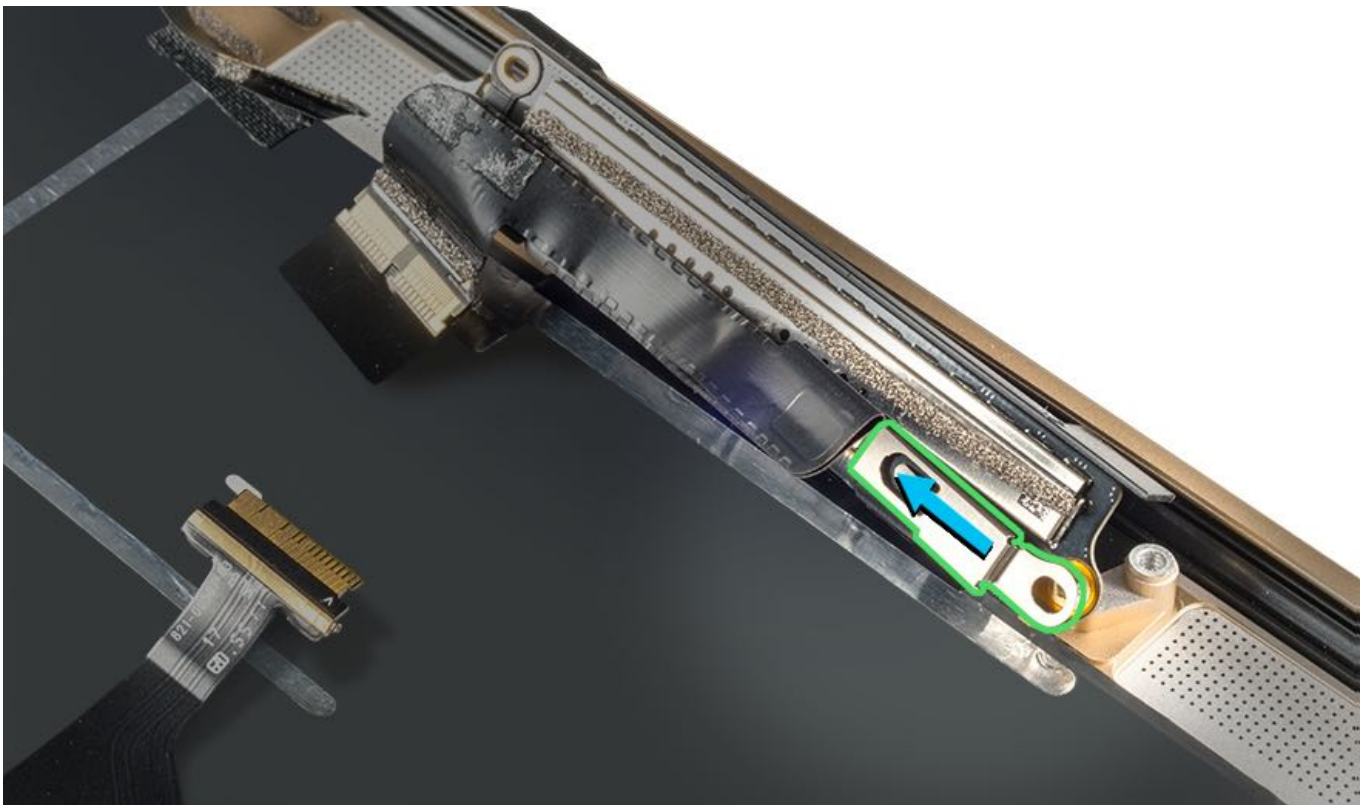
- Close the top case and check the display alignment. Adjust as necessary until the top case and bottom case are aligned.
- Tighten all four screws.



Important: Install the cowling so that it hooks securely at the left end, not just at the top of the TCON.

Note: The TCON cable cowling is pre-installed on the Early 2016 and 2017 models. The TCON cable cowling is shipped with replacement displays for the Early 2015 model. If the cowling on the 2015 model is bent or damaged, order a new one (923-01002).





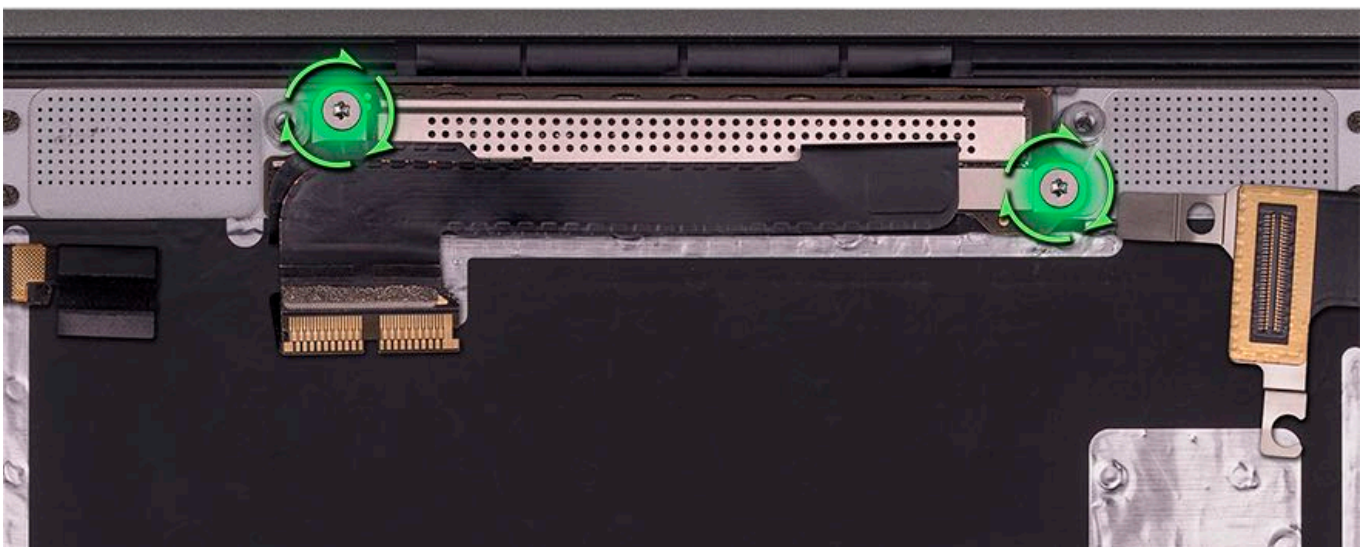
2. Reinstall two screws from the timing controller (TCON) board.

- T5: 923-00455

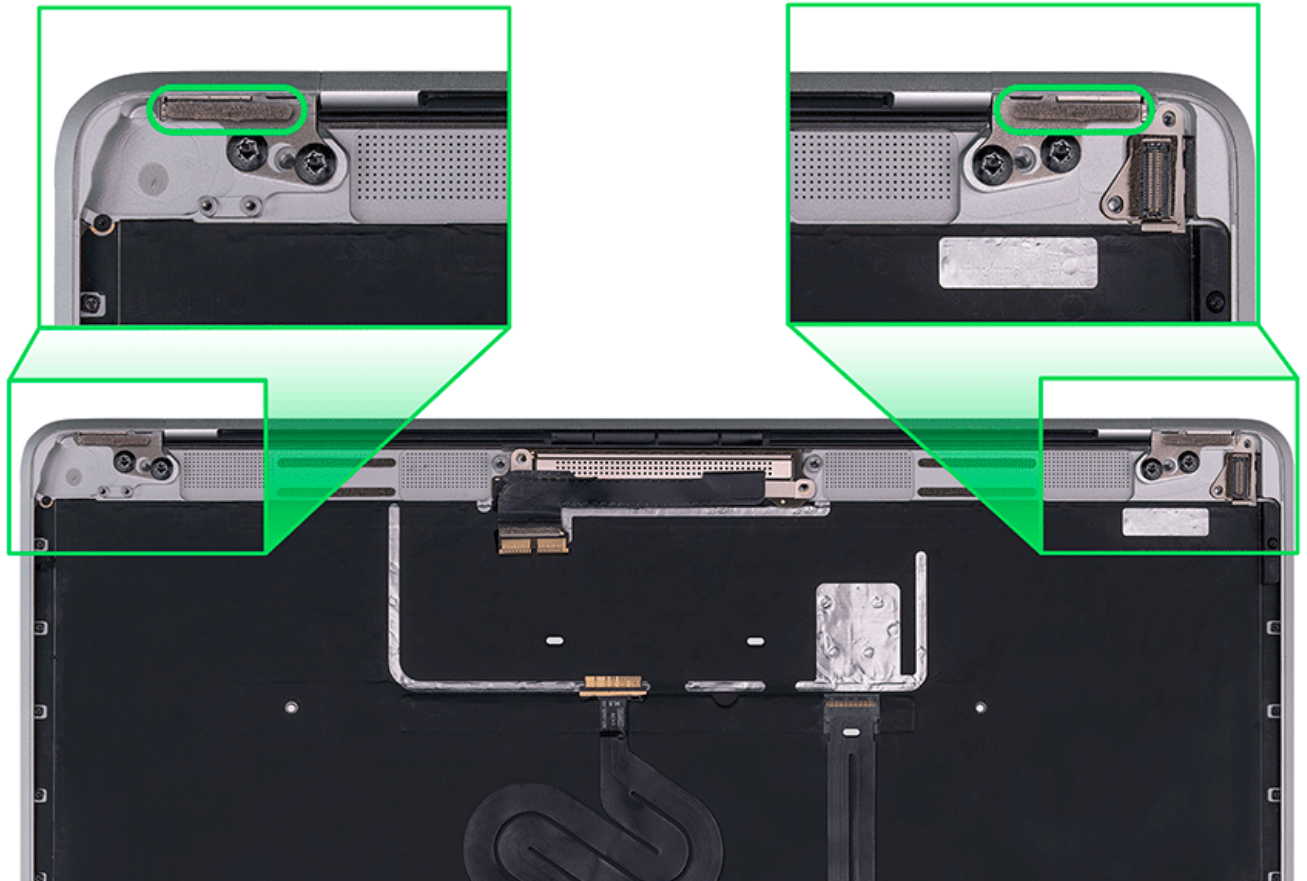


Caution:

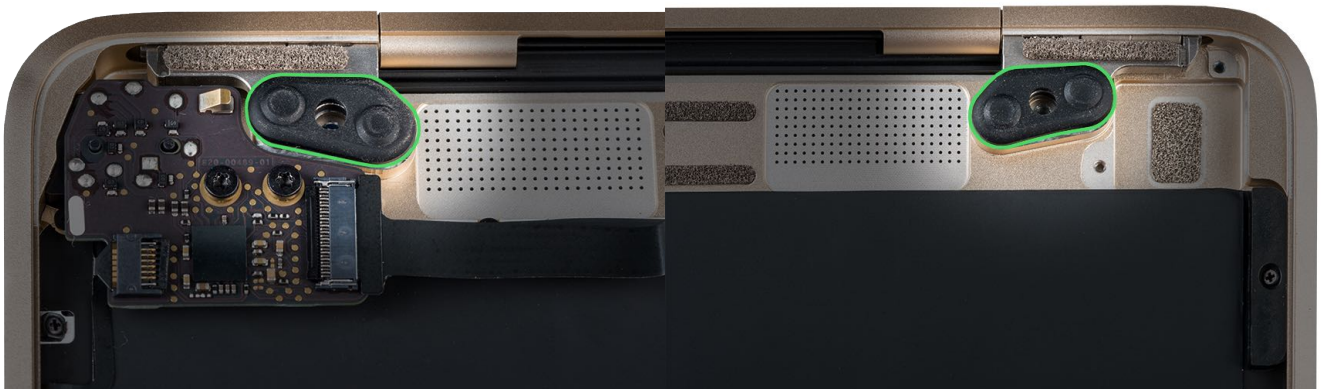
- Do not attempt to separate the TCON board from the display.
- The TCON flex cable is fragile and requires delicate handling. Ensure that it retains its shape and is not bent, pulled, or pinched during service.



3. Install the gaskets that are included with the replacement display assembly.



4. **Early 2016 and 2017:** Install the new clutch covers that are included with the replacement display assembly.



5. Reinstall the [bottom case with battery](#).
6. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
7. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Important for MacBook (Retina, 12-inch, Early 2015) only: Be sure the computer is updated to macOS Sierra version 10.12.1 or later. If the computer is running an earlier version of macOS, there may be a visual artifact that occurs briefly across the bottom of the display when waking from sleep. Updating the software will fix this issue.

Timing Controller (TCON) Board Flex Cable

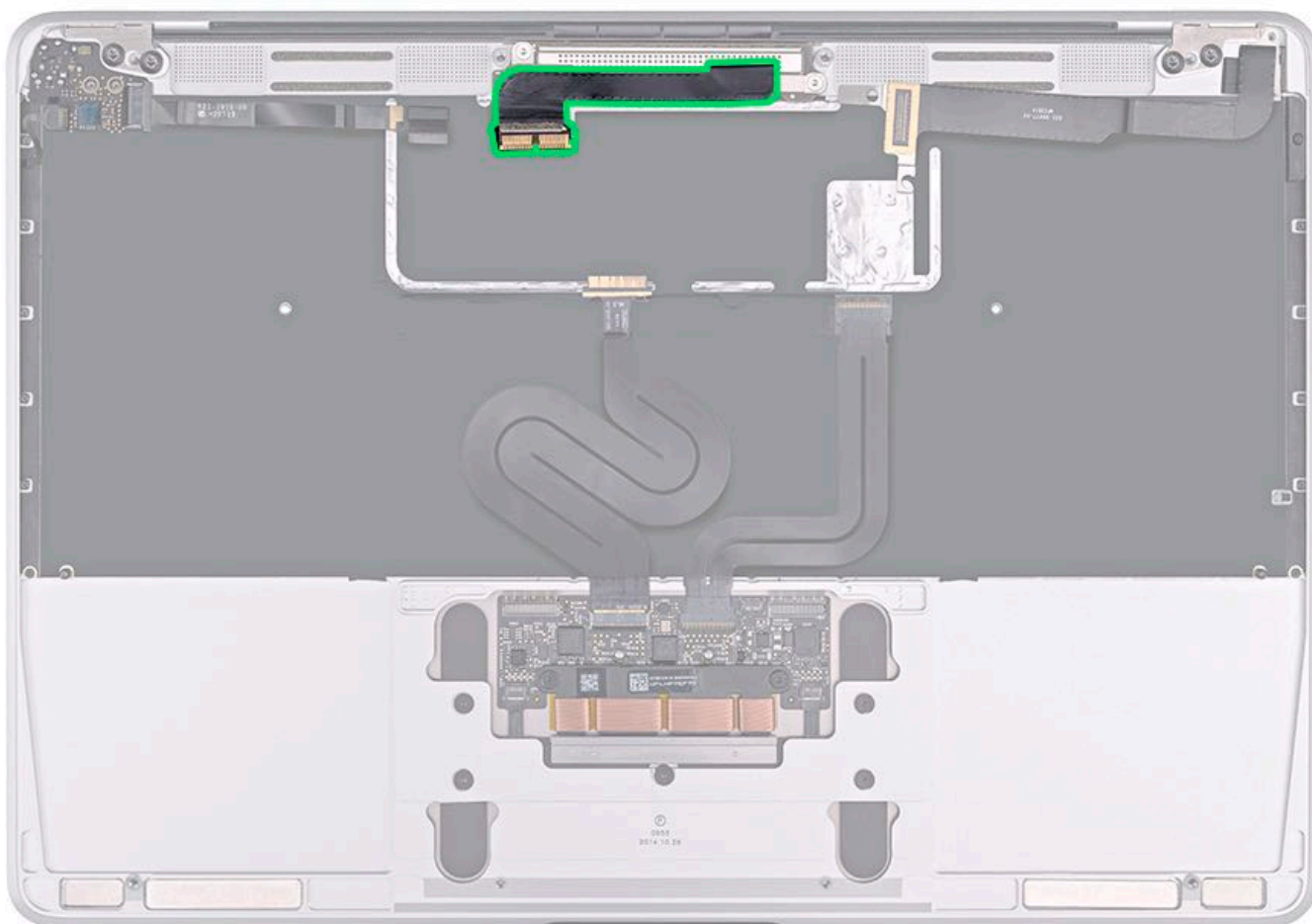
First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)



Tools

- ESD wrist strap
- Black stick

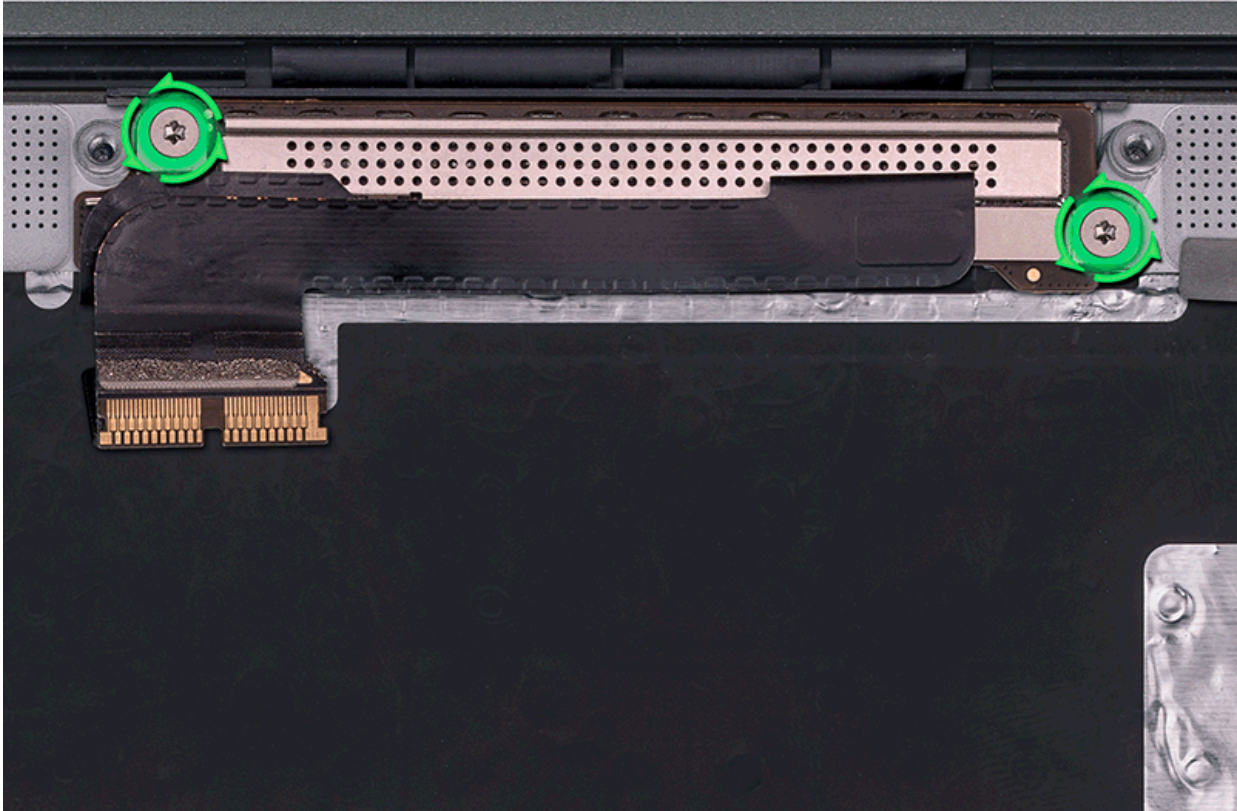


Steps For Removal

1. Remove two screws from the timing controller (TCON) board.
 - T5: 923-00455



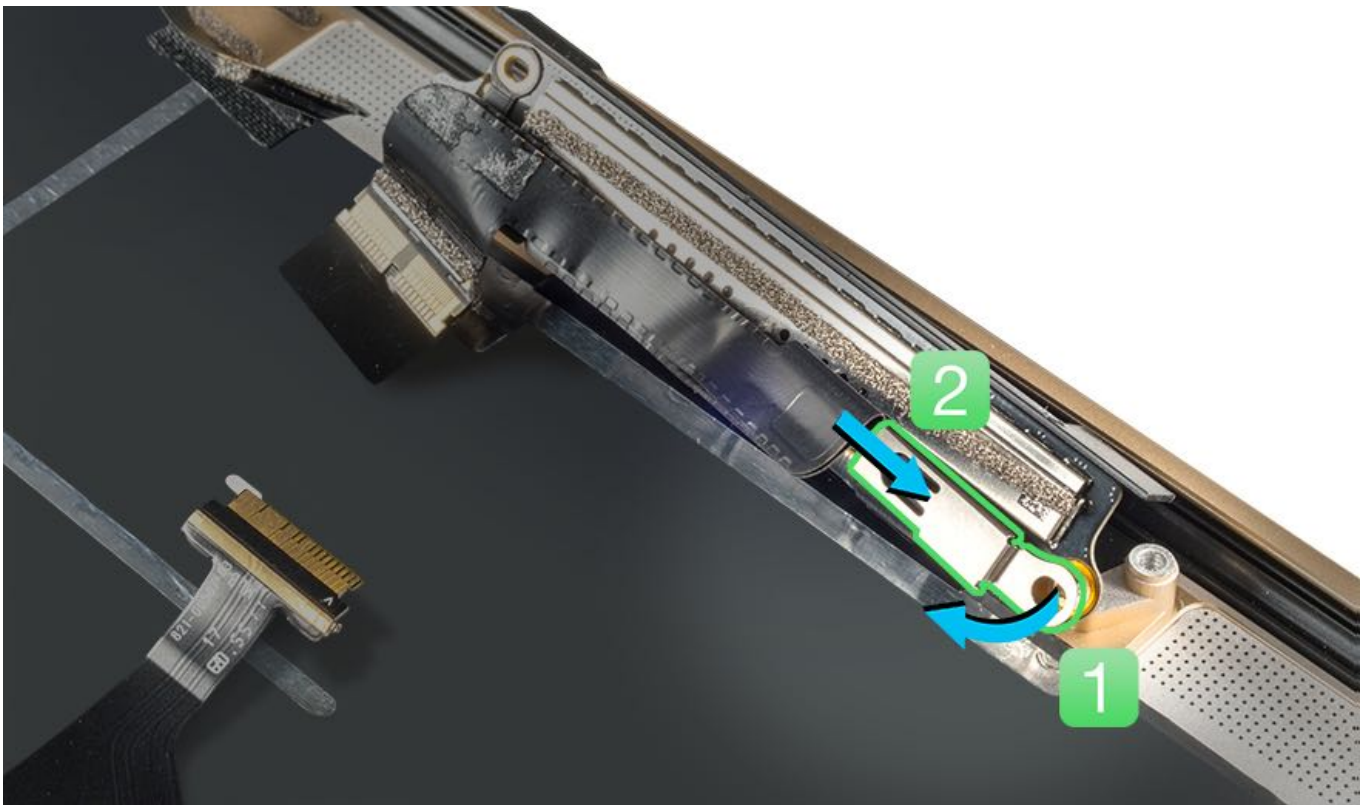
Caution: Do not attempt to separate the TCON board from the display.



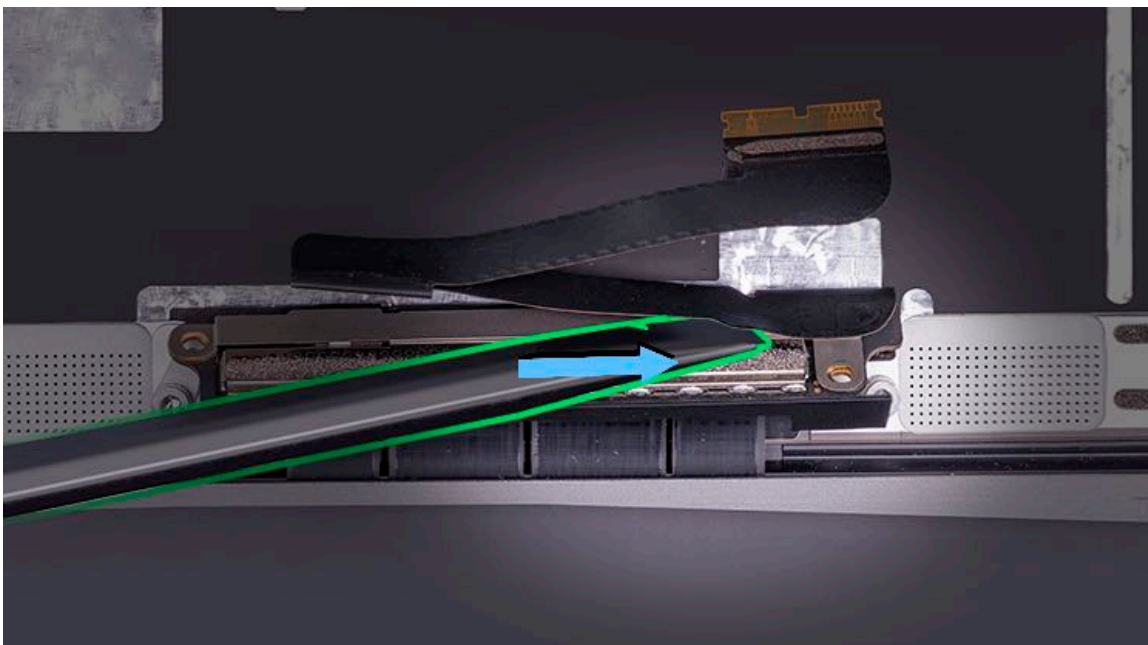
2. Tilt the cowling upward (1) then unhook and gently slide it out (2). If the cowling is intact, reuse it when reassembling the computer.

Note: The TCON cable cowling is pre-installed on the Early 2016 and 2017 models. The TCON cable cowling is shipped with replacement displays for the Early 2015 model. If the cowling on the 2015 model is bent or damaged, order a new one (923-01002).





3. Use the flat end of a black stick to loosen the adhesive between the TCON board cowling and the TCON board flex cable.



4. Gently roll the TCON board back so the flex connector is visible. Take note of how the TCON flex cable wraps around the TCON board for reassembly.

5. From the side of the connector, use the flat end of a black stick to lift the connector straight up. Be careful not to bend the connector pins.



Steps For Reassembly

1. Reassemble in reverse order of the removal steps.

Important: Install the cowling so that it hooks securely at the left end, not just at the top of the TCON.

Note: The TCON cable cowling is pre-installed on the Early 2016 and 2017 models. The TCON cable cowling is shipped with replacement displays for the Early 2015 model. If the cowling on the 2015 model is bent or damaged, order a new one (923-01002).



2. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
3. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

I/O Board and Flex Cable Assembly

First Steps

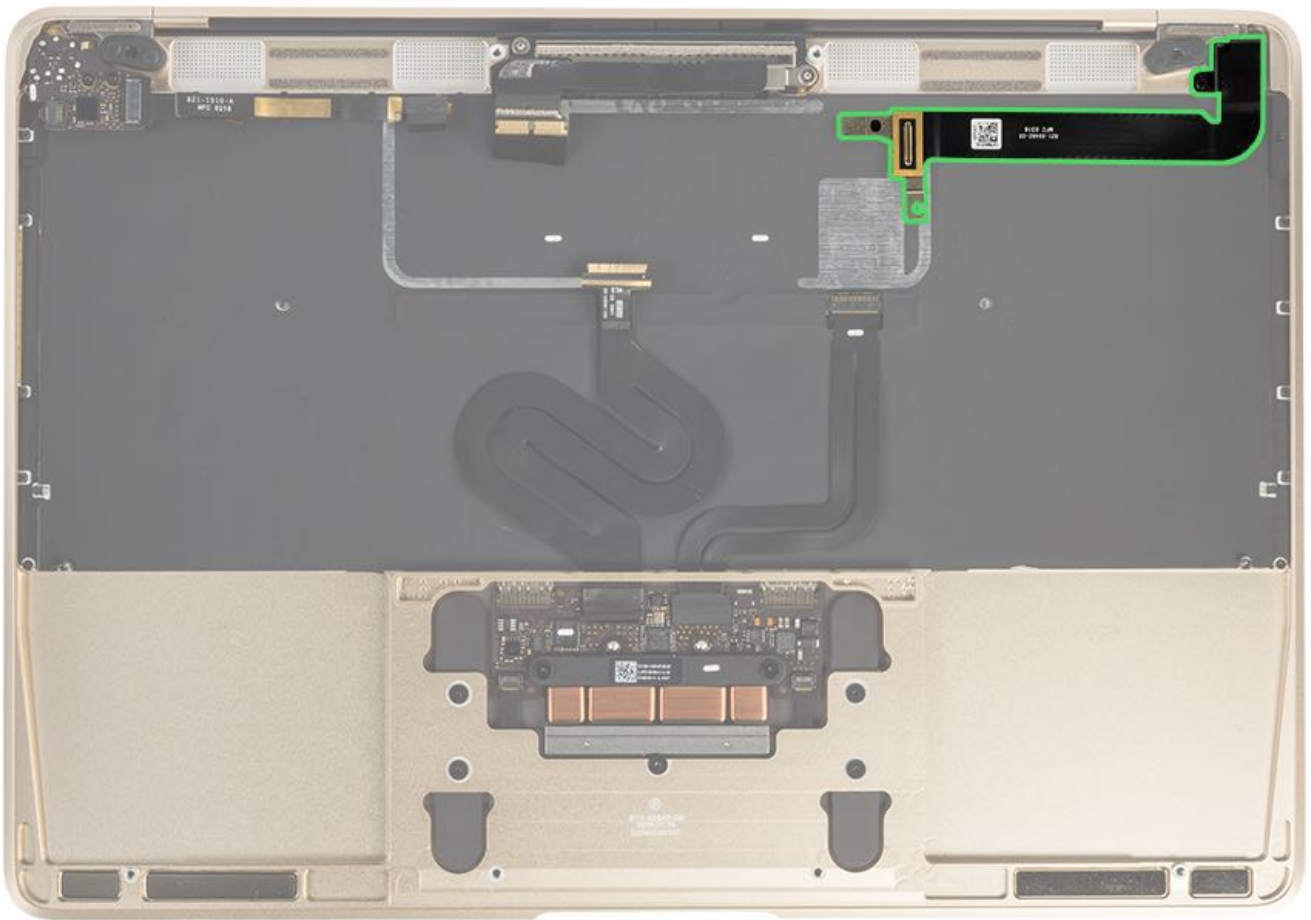
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

For video instruction, refer to article [SV301: I/O Board and Flex Cable Assembly Replacement Video](#).

Remove:

- [Bottom case with battery](#)
- [Display assembly](#)



Tools

- ESD wrist strap
- Black stick
- Phillips #000 screwdriver



Steps For Removal

1. Remove two screws from the I/O board and flex cable assembly.

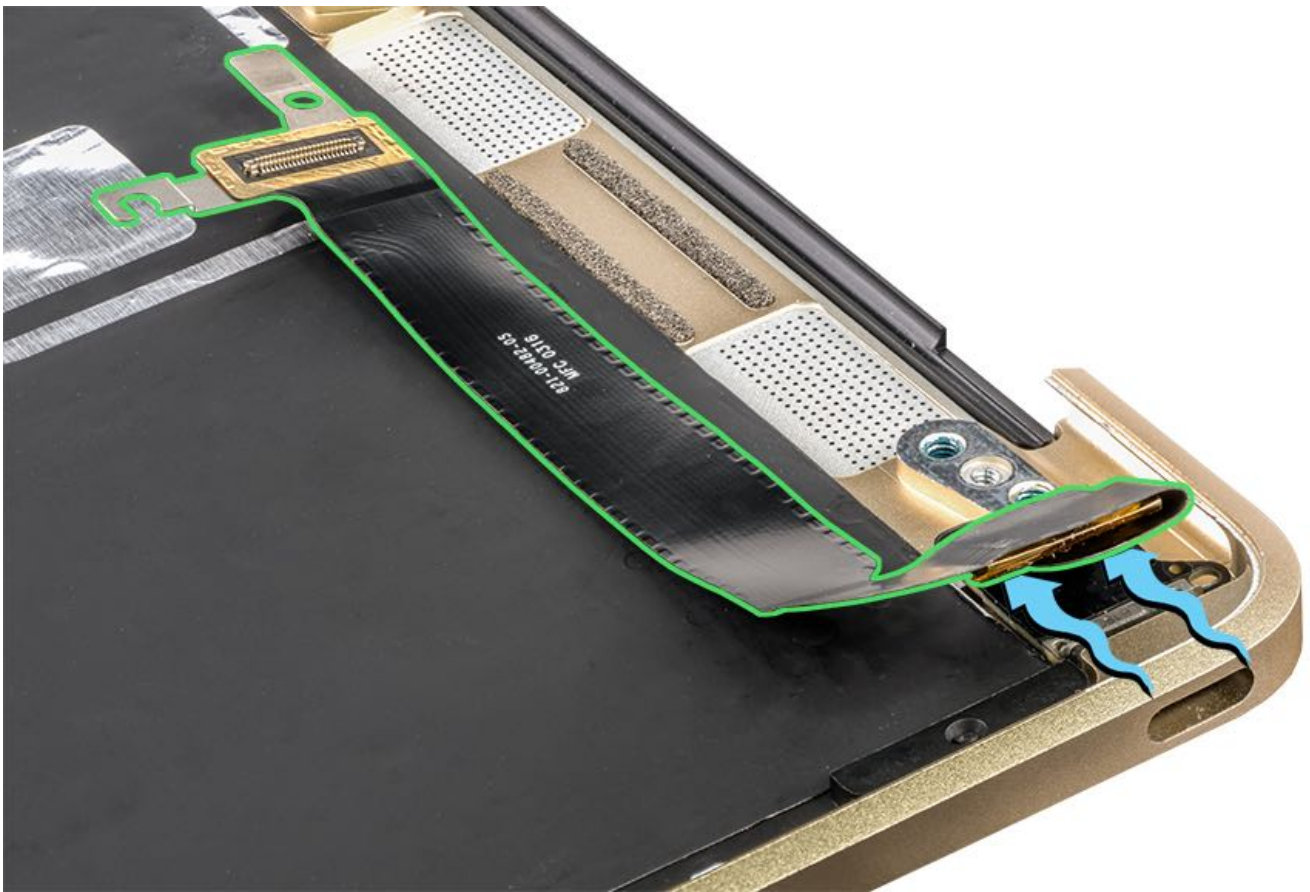
- Phillips #000, 3.09 mm, inner (923-01011)



- Phillips #000, 3.27 mm, outer (923-00424)



2. Tilt up and gently wiggle the I/O board and flex cable assembly out of the port. Be careful not to bend the cable.

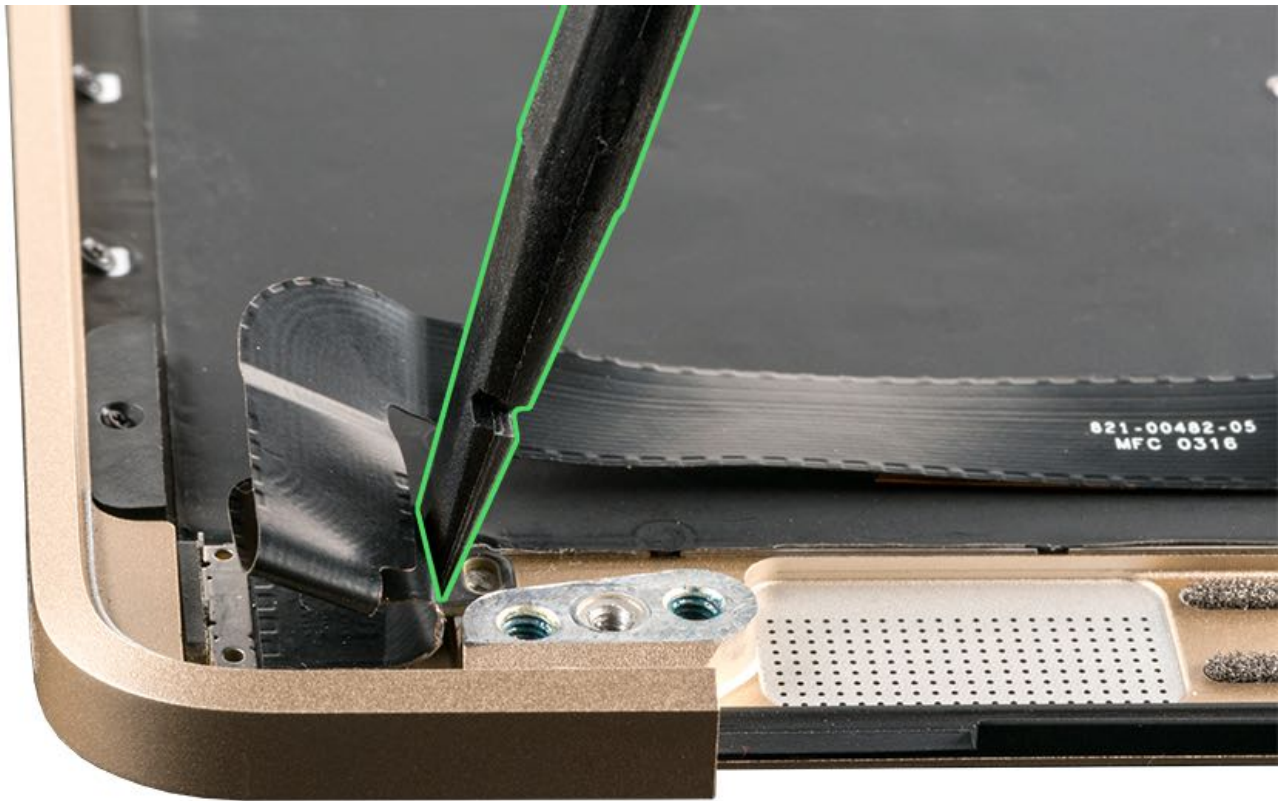


Steps For Reassembly

Note: Before inserting the I/O board and flex cable assembly into the port, check that the O-shaped rubber gasket is intact and surrounds the connector. If the gasket is bent or missing, the I/O board and flex cable assembly will have to be replaced.

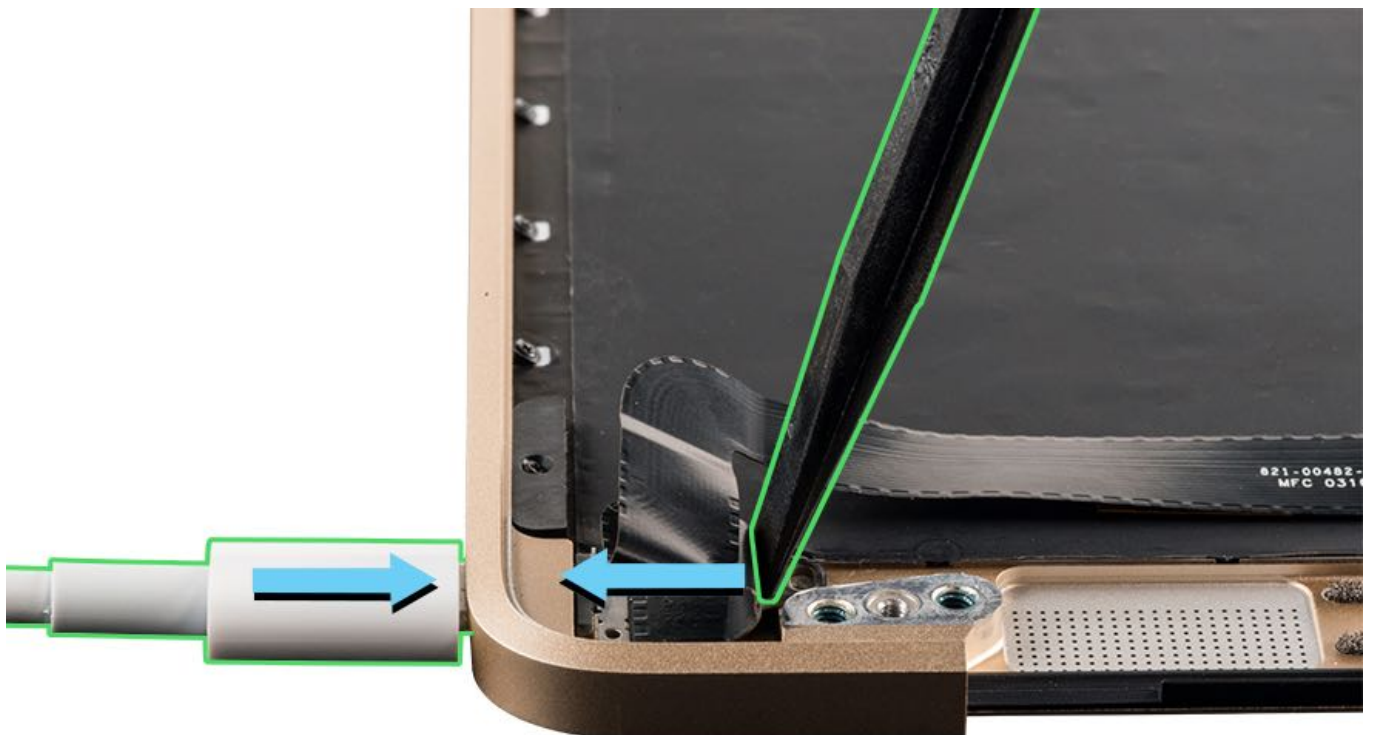


1. Insert the I/O board into the port opening in the top case.
2. Use the flat end of a black stick to keep the board in place.



3. Connect a USB-C cable to the I/O port.

Important: Make sure the cable is not connected to the power adapter.



4. Check that the screw holes are aligned, then remove the black stick.

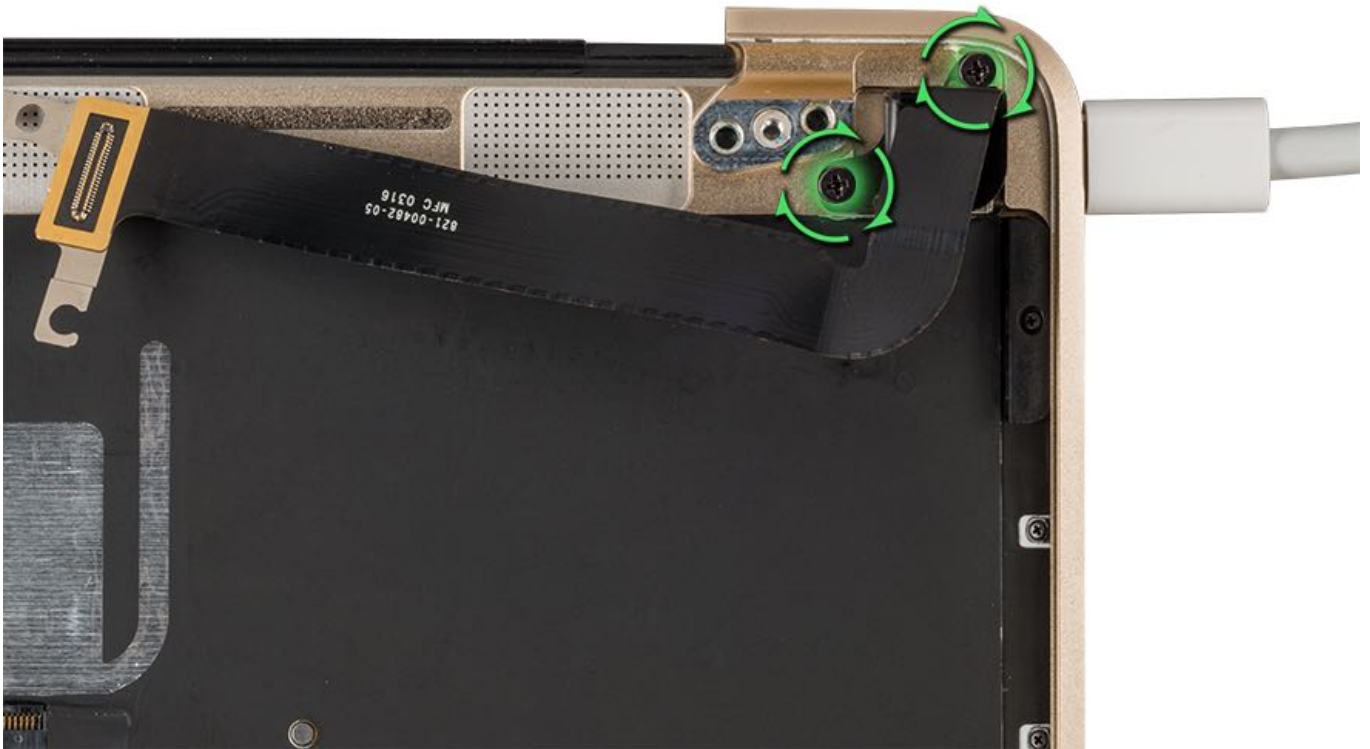
5. With the USB-C cable holding the assembly in place, reinstall the two screws.

Note: Install the screws finger tight. You might notice a gap between the bottom of the screw head and the board. This normal gap allows for slight movement of the board when the shoulder screws are fully installed.

- Phillips #000, 3.09 mm, inner (923-01011)



- Phillips #000, 3.27 mm, outer (923-00424)



6. Remove the USB-C cable from the port.
7. Reinstall the [display assembly](#).
8. Reinstall the [bottom case with battery](#).
9. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
10. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Input Device (IPD) to Keyboard Flex Cable

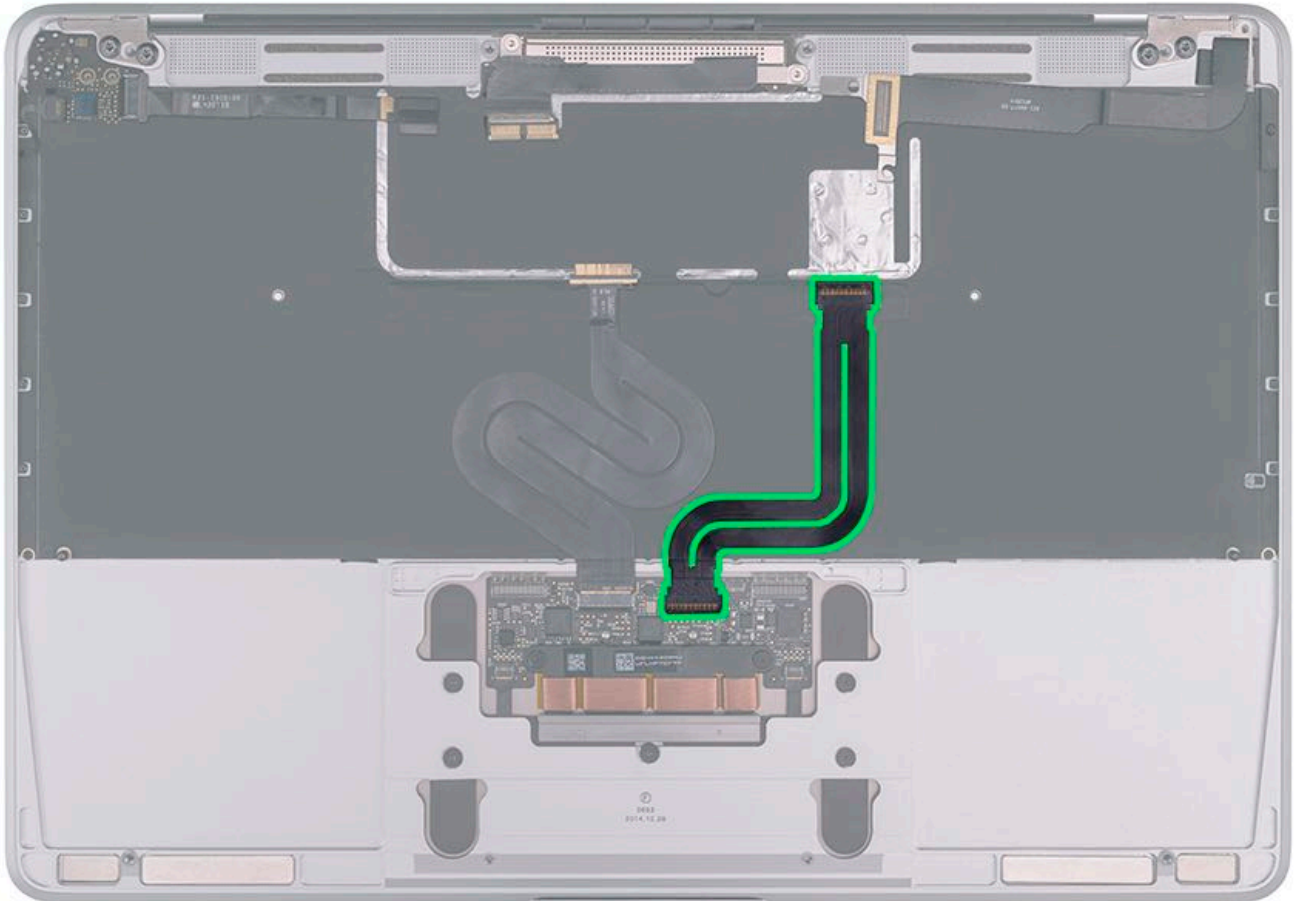
First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)



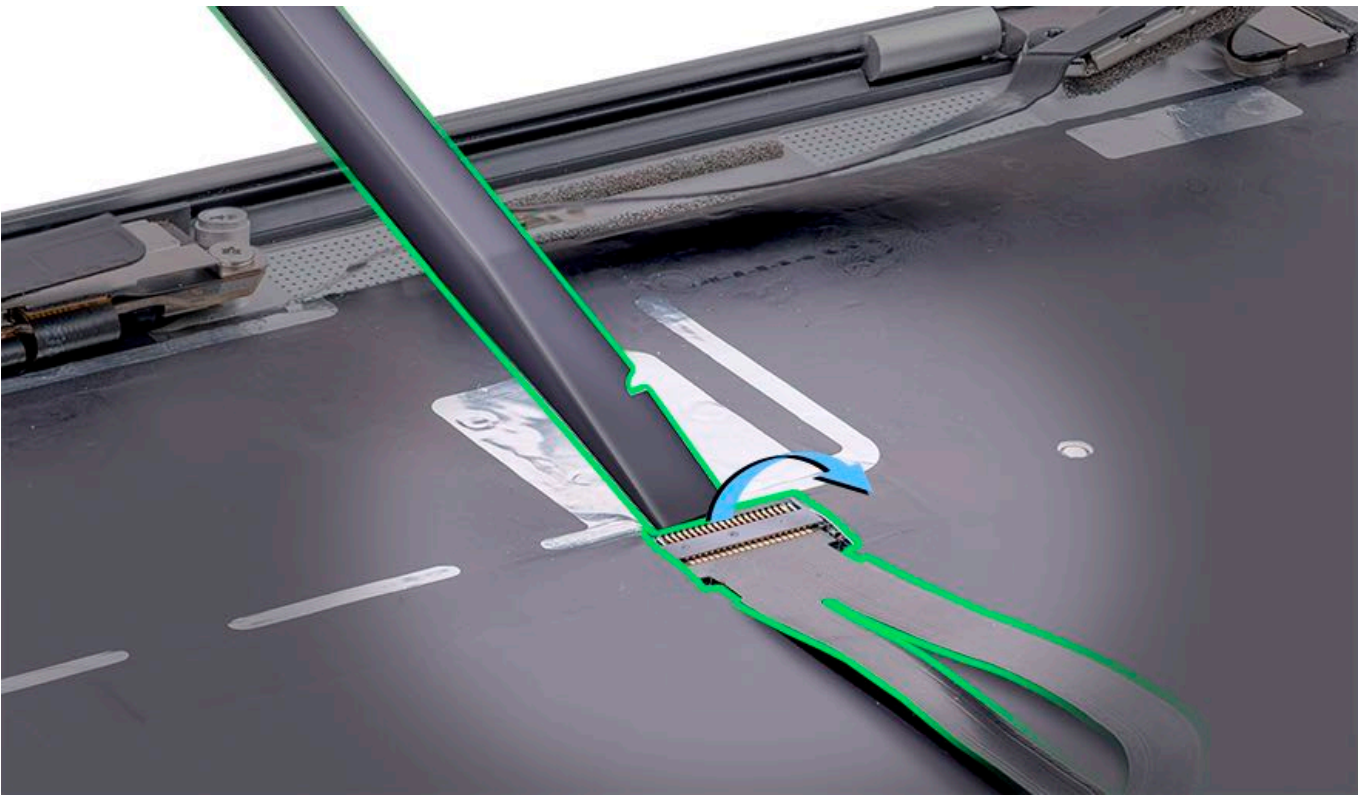
Tools

- ESD wrist strap
- Black stick



Steps For Removal

1. The IPD to keyboard flex cable is connected with locking lever connectors to both the trackpad and the top case. Flip up the locking lever to a 90-degree angle and remove the IPD to keyboard flex cable from the trackpad and the top case.

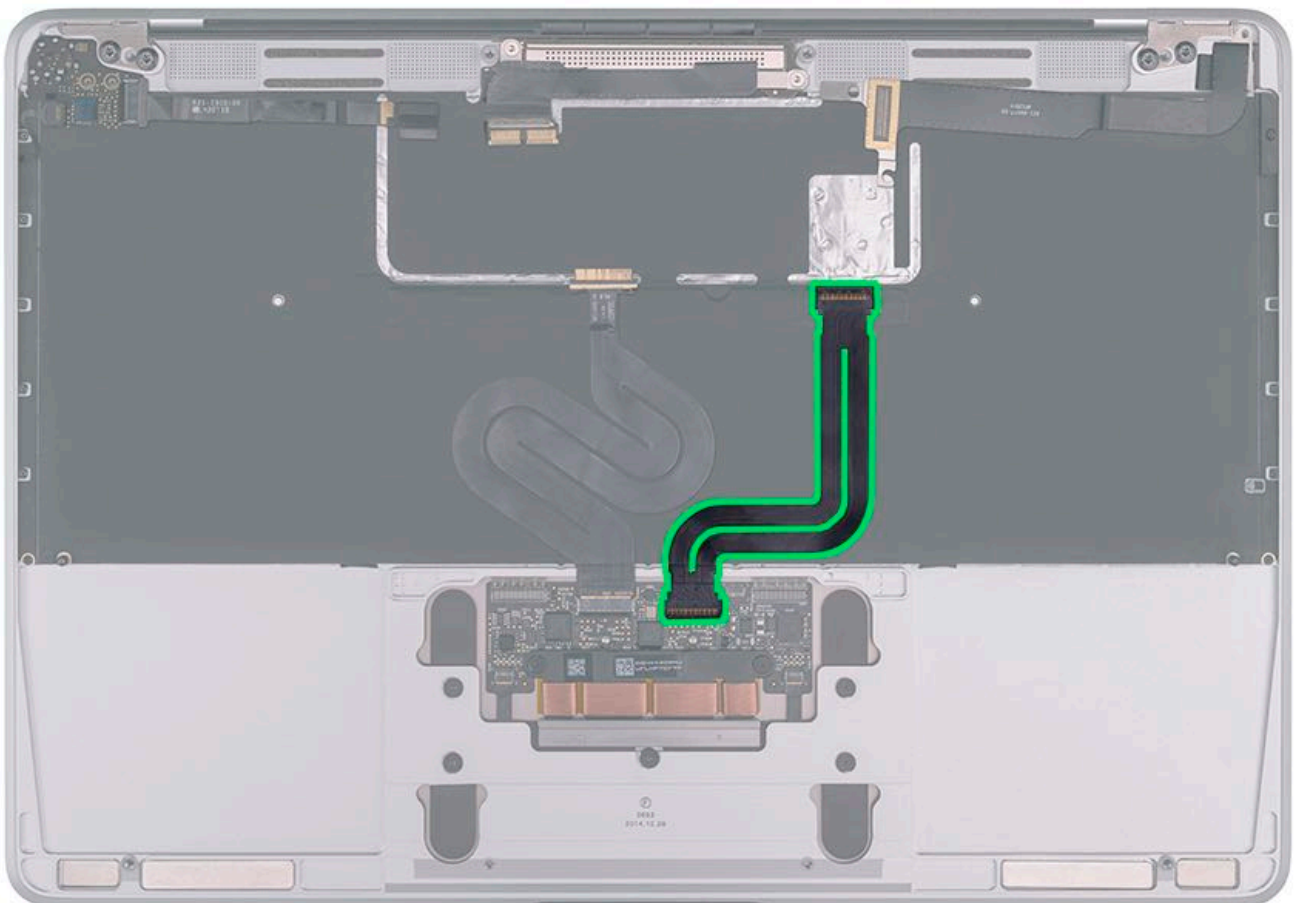


Steps For Reassembly

1. Reassemble in reverse order of removal steps.

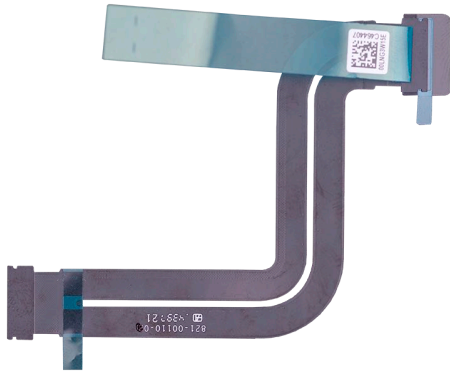
- Be sure to connect the correct side of the cable into each connector.
- Be sure to lock down the levers after inserting the cable.

Caution: Be sure corners are not bent before inserting cable into connectors.



Note: When replacing this cable on a Japanese keyboard, refer to the Exploded View for the correct part number:

- [TP1302: Exploded View for MacBook \(Retina, 12-inch, Early 2015\)](#)
- [TP1447: Exploded View for MacBook \(Retina, 12-inch, Early 2016\)](#)
- [TP1573: Exploded View for MacBook \(Retina, 12-inch, 2017\)](#)



2. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
3. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Top Case with Keyboard

First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- For MacBook (Retina, 12-inch, 2017) only: Disable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case with battery](#)
- [Audio board](#)
- [Display assembly](#)
- [I/O board](#) (Early 2015 only)
- [I/O board and flex cable assembly](#) (Early 2016 and 2017 only)
- [Input device \(IPD\) to logic board flex cable](#)

Note: The keyboard on MacBook (Retina, 12-inch, 2017) has new glyphs on the Option and Control keys. Keycap kits for MacBook (Retina, 12-inch, 2017) can be used on MacBook (Retina, 12-inch, 2016), but keycap kits for MacBook (Retina, 12-inch, 2016) can not be used on MacBook (Retina, 12-inch, 2017). The keycaps for MacBook (Retina, 12-inch, 2015) are unique and not interchangeable with any other MacBook.

MacBook (Retina, 12-inch, Early 2015 and Early 2016)



MacBook (Retina, 12-inch, 2017)



Tools

None required.

Steps For Removal

With the first steps completed, the top case (with keyboard, microphone, and trackpad) is the only remaining component.

The top case assembly includes the following parts:

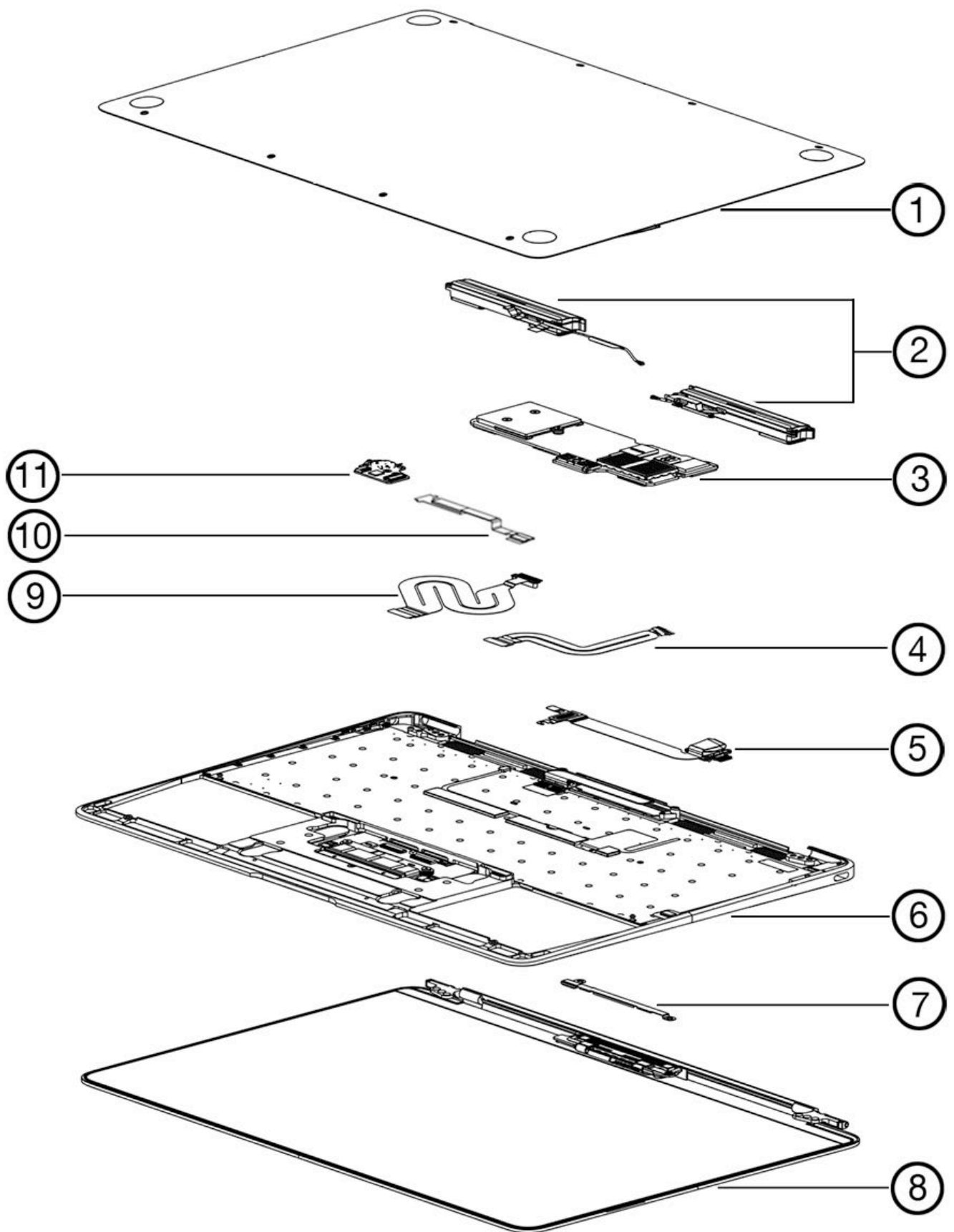
- keyboard
- microphone
- trackpad
- keyboard to IPD flex cable

Steps For Reassembly

1. Reassemble in reverse order of the removal steps. However, reinstall the I/O board before the display assembly.
2. The Microphone Equalization Reset, found in AST 2, must be run after installing a new top case.
3. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
4. For MacBook (Retina, 12-inch, 2017) only: Re-enable the Auto Boot features. Refer to article [TP1484: Auto Boot](#).

Exploded View

Exploded View for MacBook (Retina, 12-inch, Early 2016)



1. Bottom Case with Battery

- 661-04856, Bottom Case with Battery, Space Gray
- 661-04855, Bottom Case with Battery, Silver

- 661-04858, Bottom Case with Battery, Gold
- 661-04876, Bottom Case with Battery, Rose Gold

2. Speaker/Antenna Modules

- 923-00996, Speaker/Antenna Modules
- ID923-00996, Speaker/Antenna Modules, Indonesia

3. Logic Board

- 661-04728, Logic Board, FCC, 1.1GHz, 256GB
- 661-04731, Logic Board, ETSI, 1.1GHz, 256GB
- 661-04732, Logic Board, ROW, 1.1GHz, 256GB
- 661-04730, Logic Board, FCC, 1.2GHz, 512GB
- 661-04733, Logic Board, ETSI, 1.2GHz, 512GB
- 661-04734, Logic Board, ROW, 1.2GHz, 512GB
- 661-04729, Logic Board, FCC, 1.3GHz, 256GB
- 661-04735, Logic Board, ETSI, 1.3GHz, 256GB
- 661-04736, Logic Board, ROW, 1.3GHz, 256GB
- 661-04737, Logic Board, FCC, 1.3GHz, 512GB
- 661-04738, Logic Board, ETSI, 1.3GHz, 512GB
- 661-04739, Logic Board, ROW, 1.3GHz, 512GB

4. Keyboard to Input Device (IPD) Flex Cable

- 923-00408, Keyboard to IPD Flex Cable (ANSI/ISO)
- 923-00442, Keyboard to IPD Flex Cable (JIS)

5. I/O Board and Flex Cable Assembly

- 923-00997, I/O Board and Flex Cable Assembly

6. Top Case with Keyboard (includes microphone)

- 661-04882, Top Case with Keyboard, Space Gray
- 661-04881, Top Case with Keyboard, Silver
- 661-04883, Top Case with Keyboard, Gold
- 661-04884, Top Case with Keyboard, Rose Gold

Note: Regional top cases have the same base part number, but they include a language code prefix (i.e. C661-02242). Prefixes are:

- AB: Arabic
- B: British
- BG: Bulgarian
- C: Canadian French
- CR: Croatian
- CZ: Czech
- D: German
- DK: Danish
- E: Spanish
- F: French
- GR: Greek
- H: Norwegian
- HB: Hebrew
- J: Japanese
- KH: Korean
- MG: Hungarian
- N: Dutch
- PO: Portuguese
- RO: Romanian
- RS: Russian
- S: Swedish
- SF: Swiss French
- SL: Slovak
- T: Italian
- TA: Taiwanese
- TH: Thai
- TQ: Turkish-Q
- TU: Turkish-F
- Z: English International

7. Timing Controller (TCON) Board Flex Cable

- 923-01004, TCON Board Flex Cable

8. Display Assembly

- 661-04746, Display Assembly, Space Gray
- 661-04744, Display Assembly, Silver
- 661-04745, Display Assembly, Gold
- 661-04852, Display Assembly, Rose Gold

9. Input Device (IPD) to Logic Board Flex Cable

- 923-01005, IPD to Logic Board Flex Cable
- 923-01006, IPD to Logic Board Flex Cable (Japan)

10. Audio Board Flex Cable

- 923-01003, Audio Board Flex Cable

11. Audio Board

- 923-00999, Audio Board, Space Gray
- 923-00998, Audio Board, Silver
- 923-01000, Audio Board, Gold / Rose Gold

Not Shown:

29W Power Adapter

- 661-02315, US
- AR661-02315, Argentina
- LA661-02315, Latin America
- MY661-02315, Malay
- PA661-02315, PAL Pacific
- TA661-02315, Taiwan
- ZM661-02315, Brazil, Japan, International

USB-C Charge Cable

- 923-00495, US
- CH923-00495, China
- ID923-00495, Indonesia
- ZM923-00495, International

Data Transfer Cable

- 923-00504, USB-C to USB-A Cable

Power Cord

- 923-00480, US
- B923-00480, Great Britain
- BZ923-00480, Brazil
- CH923-00480, China
- CI923-00480, Chile
- D923-00480, Germany
- DK923-00480, Denmark
- HB923-00480, Israel
- HN923-00480, India
- J923-00480, Japan
- LE923-00480, Latin America
- SM923-00480, Switzerland
- SO923-00480, South Africa
- TA923-00480, Taiwan
- TH923-00480, Thailand
- X923-00480, Australia
- Z923-00480, Asia

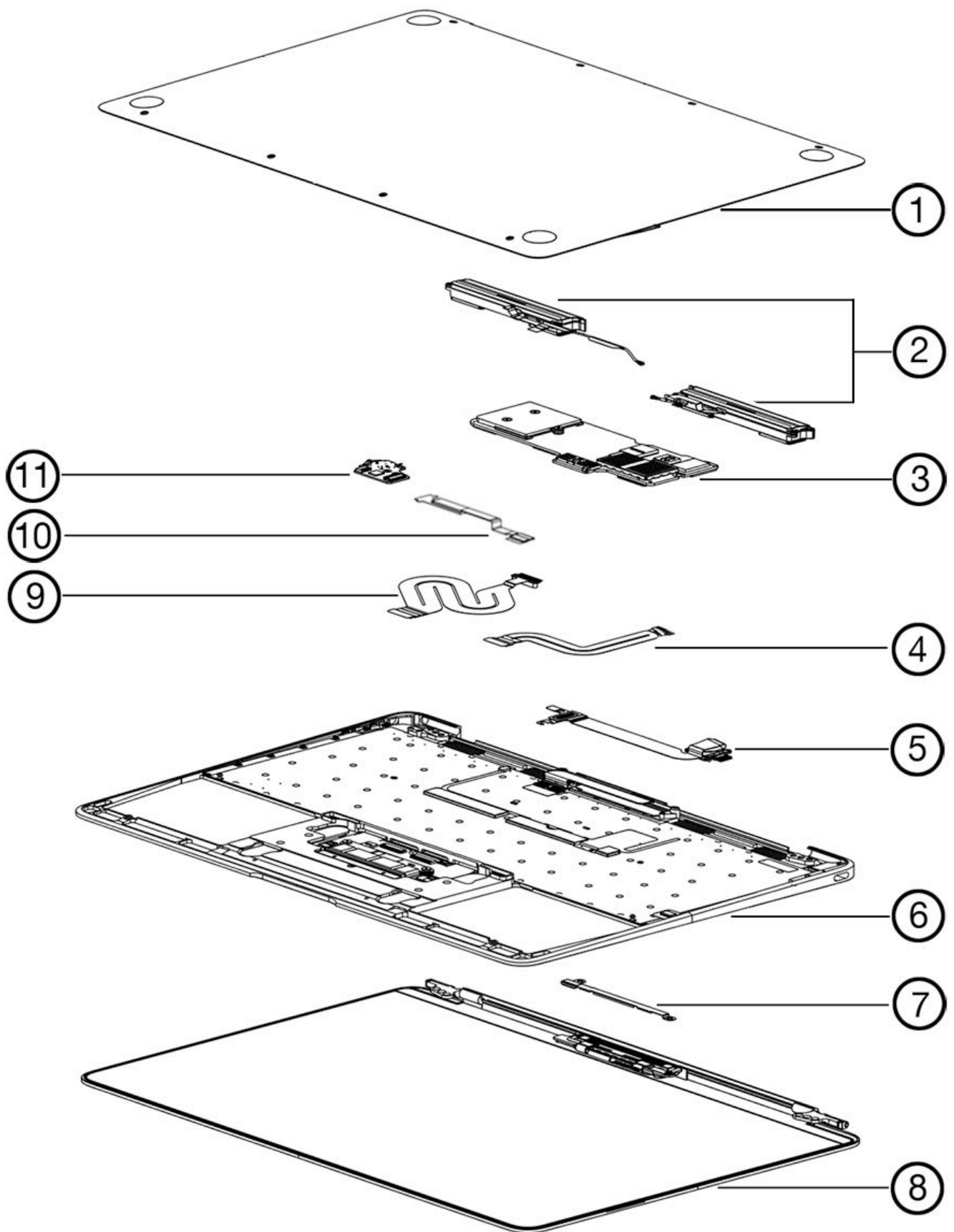
5W Power Adapter (Used for applying low voltage power after the MacBook is reassembled.)

- 661-4954, US

- C661-4954, Canada
- J661-4954, Japan
- 661-6365, Europe
- 661-02306, UK
- 661-8241, Korea
- 661-8243, Australia
- CH923-0297, China

Exploded View

Exploded View for MacBook (Retina, 12-inch, 2017)



1. Bottom Cases with Battery

- 661-06789, Bottom Case with Battery, Space Gray
- 661-06790, Bottom Case with Battery, Silver

- 661-06791, Bottom Case with Battery, Gold
- 661-06792, Bottom Case with Battery, Rose Gold

2. Speaker/Antenna Modules

- 923-01077, Speaker/Antenna Modules

3. Logic Board

- 661-06769, Logic Board, ETSI, 1.2 GHz, 8GB, 256GB
- 661-06770, Logic Board, FCC, 1.2 GHz, 8GB, 256GB
- 661-06771, Logic Board, ETSI, 1.2 GHz, 16GB, 256GB
- 661-06772, Logic Board, FCC, 1.2 GHz, 16GB, 256GB
- 661-06773, Logic Board, ETSI, 1.3 GHz, 8GB, 256GB
- 661-06774, Logic Board, FCC, 1.3 GHz, 8GB, 256GB
- 661-06775, Logic Board, FCC, 1.3 GHz, 8GB, 512GB
- 661-06776, Logic Board, ETSI, 1.3 GHz, 8GB, 512GB
- 661-06777, Logic Board, FCC, 1.3 GHz, 16GB, 256GB
- 661-06778, Logic Board, FCC, 1.3 GHz, 16GB, 512GB
- 661-06779, Logic Board, ETSI, 1.3 GHz, 16GB, 256GB
- 661-06780, Logic Board, FCC, 1.4 GHz, 8GB, 256GB
- 661-06781, Logic Board, FCC, 1.4 GHz, 8GB, 512GB
- 661-06782, Logic Board, ETSI, 1.3 GHz, 16GB, 512GB
- 661-06783, Logic Board, FCC, 1.4 GHz, 16GB, 256GB
- 661-06784, Logic Board, FCC, 1.4 GHz, 16GB, 512GB
- 661-07860, Logic Board, ETSI, 1.4 GHz, 8GB, 256GB
- 661-07861, Logic Board, ETSI, 1.4 GHz, 8GB, 512GB
- 661-07862, Logic Board, ETSI, 1.4 GHz, 16GB, 256GB
- 661-07863, Logic Board, ETSI, 1.4 GHz, 16GB, 512GB
- 661-07864, Logic Board, ROW, 1.2 GHz, 8GB, 256GB,
- 661-07865, Logic Board, ROW, 1.2 GHz, 16GB, 256GB
- 661-07866, Logic Board, ROW, 1.3 GHz, 8GB, 256GB
- 661-07867, Logic Board, ROW, 1.3 GHz, 8GB, 512GB
- 661-07868, Logic Board, ROW, 1.3 GHz, 16GB, 256GB
- 661-07869, Logic Board, ROW, 1.3 GHz, 16GB, 512GB
- 661-07870, Logic Board, ROW, 1.4 GHz, 8GB, 256GB
- 661-07871, Logic Board, ROW, 1.4 GHz, 8GB, 512GB
- 661-07872, Logic Board, ROW, 1.4 GHz, 16GB, 256GB
- 661-07873, Logic Board, ROW, 1.4 GHz, 16GB, 512GB

4. Keyboard to Input Device (IPD) Flex Cable

- 923-00408, Keyboard to IPD Flex Cable (ANSI/ISO)
- 923-00442, Keyboard to IPD Flex Cable (JIS)

5. I/O Board and Flex Cable Assembly

- 923-01751, I/O Board and Flex Cable Assembly

6. Top Case with Keyboard (includes microphone)

- 661-06793 Top Case with Keyboard, Space Gray
- 661-06794 Top Case with Keyboard, Silver
- 661-06795 Top Case with Keyboard, Gold
- 661-06796 Top Case with Keyboard, Rose Gold

Note: Regional top cases have the same base part number, but include a language code prefix. For example, HB661-06796 is for Hebrew. Prefixes are:

- AB: Arabic
- B: British
- BG: Bulgarian
- C: Canadian French
- CR: Croatian
- CZ: Czech
- D: German
- DK: Danish
- E: Spanish
- F: French
- GR: Greek
- H: Norwegian
- HB: Hebrew

- J: Japanese
- KH: Korean
- MG: Hungarian
- N: Dutch
- PO: Portuguese
- RO: Romanian
- RS: Russian
- S: Swedish
- SF: Swiss French
- SL: Slovak
- T: Italian
- TA: Taiwanese
- TH: Thai
- TQ: Turkish-Q
- TU: Turkish-F
- Z: English International

7. Timing Controller (TCON) Board Flex Cable

- 923-01004, TCON Board Flex Cable

8. Display Assembly

- 661-06785 Display Assembly, Space Gray
- 661-06786 Display Assembly, Silver
- 661-06787 Display Assembly, Gold
- 661-06788 Display Assembly, Rose Gold

9. Input Device (IPD) to Logic Board Flex Cable

- 923-01005, IPD to Logic Board Flex Cable
- 923-01006, IPD to Logic Board Flex Cable (Japan)

10. Audio Board Flex Cable

- 923-01773, Audio Board Flex Cable

11. Audio Board

- 923-00999, Audio Board, Space Gray
- 923-00998, Audio Board, Silver
- 923-01000, Audio Board, Gold / Rose Gold

Not Shown:

29W Power Adapter

- 661-02315, US
- AR661-02315, Argentina
- LA661-02315, Latin America
- MY661-02315, Malaysia
- PA661-02315, PAL Pacific
- TA661-02315, Taiwan
- ZM661-02315, Brazil, Japan, International

USB-C Charge Cable

- 923-00495, US
- CH923-00495, China
- ID923-00495, Indonesia
- ZM923-00495, International

Data Transfer Cable

- 923-00504, USB-C to USB-A Cable

Power Cord

- 923-00480, US

5W Power Adapter (Used for applying low voltage power after the MacBook is reassembled.)

- 661-4954, US

Screw Chart

Screw Chart for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

923-00414 - Silver
923-00430 - Space Gray
923-00409 - Gold
923-01038 - Rose Gold
Pentalobe



Bottom case with battery (2)

923-00415 - Silver
923-00431 - Space Gray
923-00427 - Gold
923-01039 - Rose Gold
Pentalobe



Bottom case with battery (2)

923-00416 - Silver
923-00432 - Space Gray
923-00406 - Gold
923-01040 - Rose Gold
Pentalobe



Bottom case with battery (4)

923-00417
Trilobe #000
Phillips #000



I/O board flex cable (upper) to logic board (1)
(Trilobe or Phillips)

923-00419
Torx T5



Logic board to bottom case
with battery (1)

I/O board flex cable (lower) to
logic board (1)

923-00420 (Early 2015)
923-01013 (Early 2016 and 2017)
Torx T3



Speaker/antenna module to bottom case with
battery (4)

923-00421
Torx T5



Audio board to top case with keyboard (1)

923-00423
Torx T3



I/O board to top case with
keyboard (1)

923-00424
Phillips #000



Top case side of I/O flex cable (1) (Early
2015)

Outer screw for I/O Board and Flex Cable
Assembly (1) (Early 2016 and 2017)

923-00425
Torx T5



Logic board to bottom case with battery,
grounding screw (1)

923-00426
Torx T8



Display assembly clutch (4)

923-00455 (Early 2015)
923-01015 (Early 2016 and 2017)
Torx T5



Timing controller (TCON) board (2)

923-01011
Phillips #000



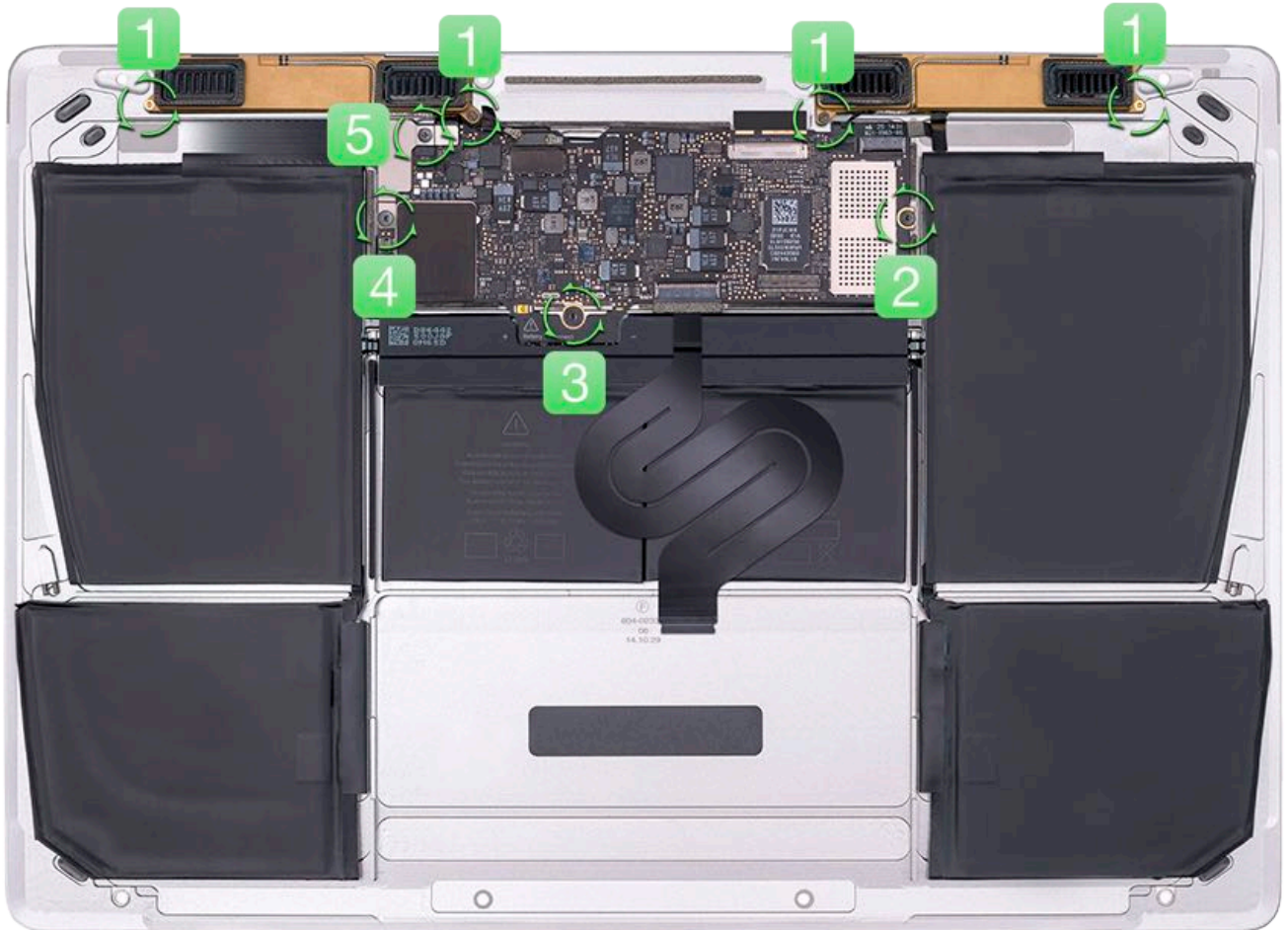
Inner screw for I/O Board and Flex Cable
Assembly (1) (Early 2016 and 2017)

Screw Location Diagrams

Screw Location Diagrams for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

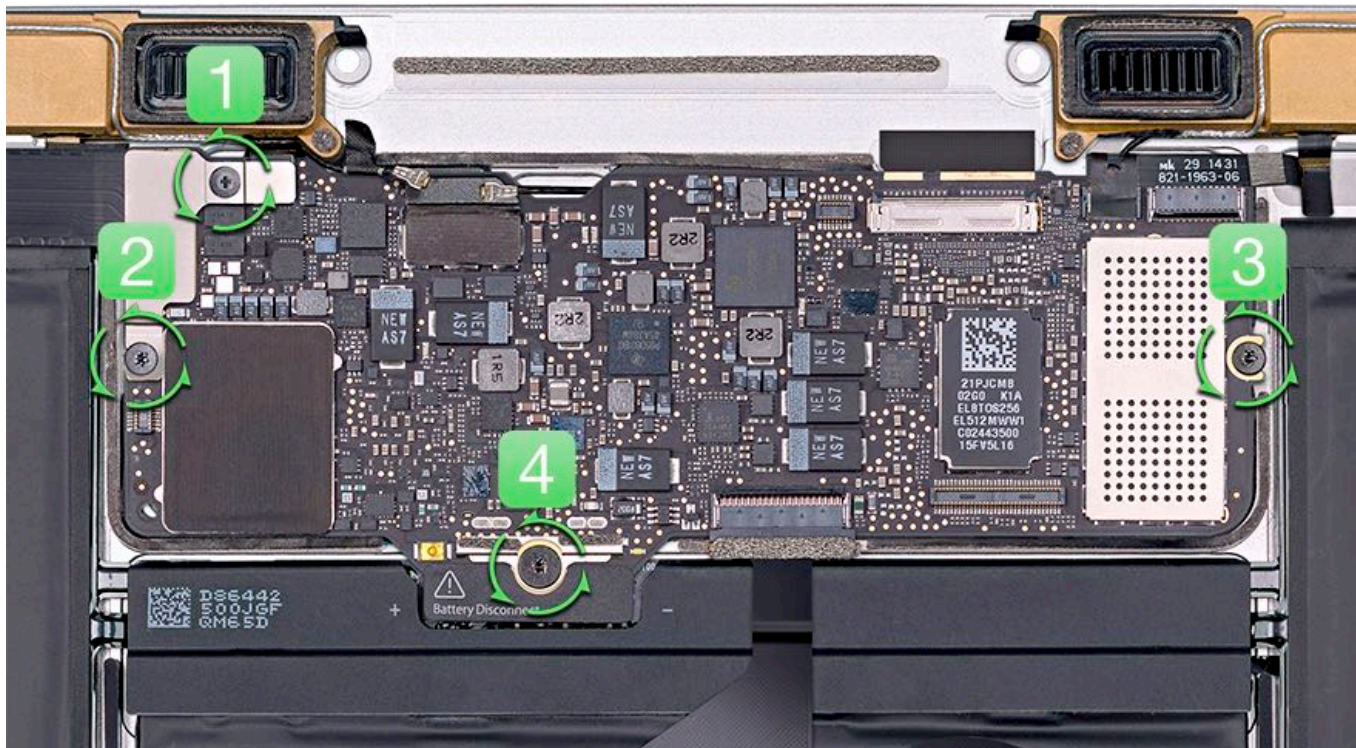
Bottom Case

1. Speaker/antenna modules
 - 923-00420, Early 2015 (**Note:** Early 2015 has foam gaskets.)
 - 923-01013, Early 2016 and 2017
2. Logic board - 923-00419
3. Logic board (ground screw) - 923-00425 (**Note:** Early 2015 has a butterfly bracket.)
4. I/O board flex cable - 923-00419
5. I/O board flex cable - 923-00417



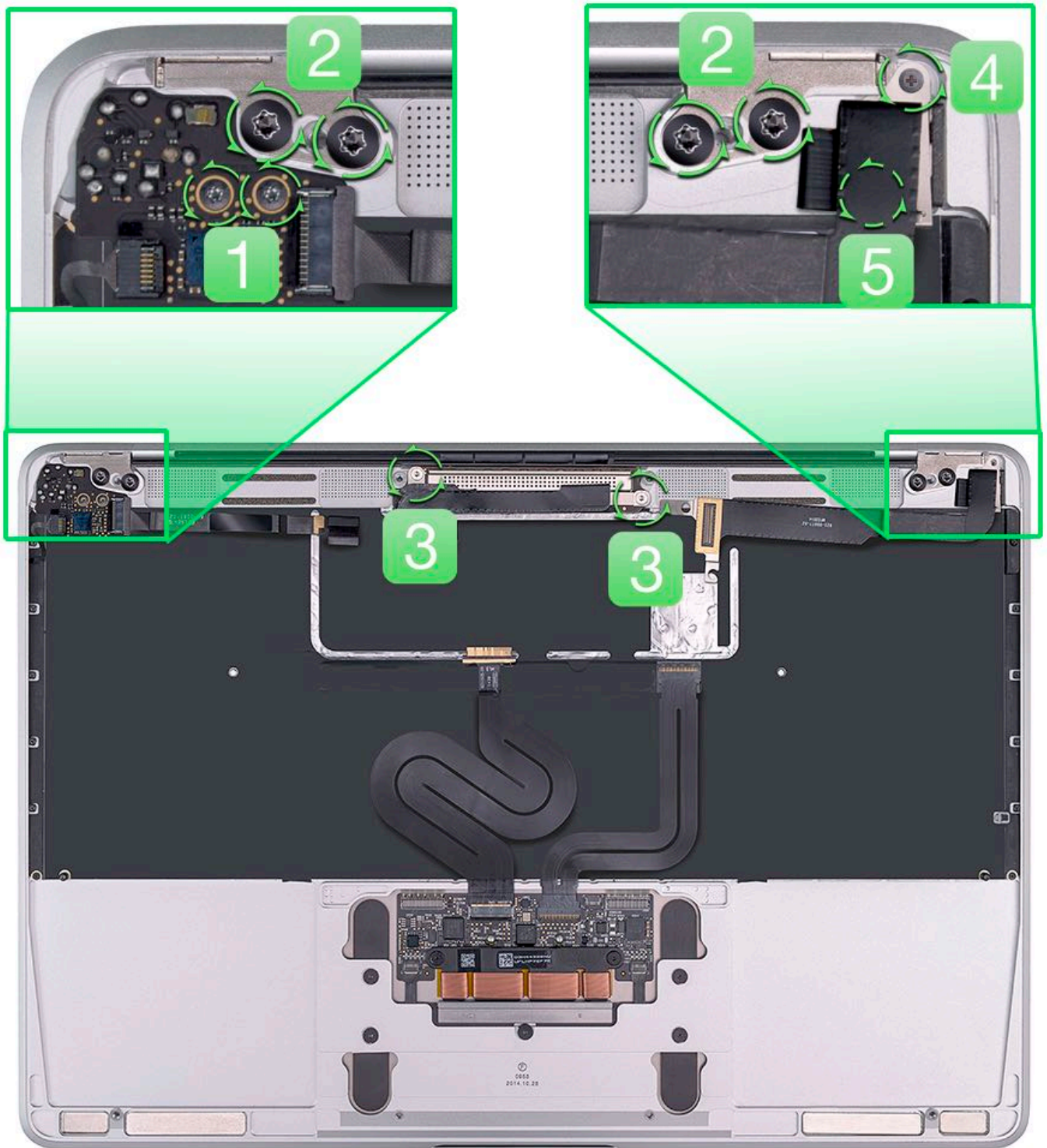
Logic Board

1. I/O board flex cable - 923-00417
2. I/O board flex cable - 923-00419
3. Logic board - 923-00419
4. Logic board (ground screw) - 923-00425 (**Note:** Early 2015 has a butterfly bracket.)



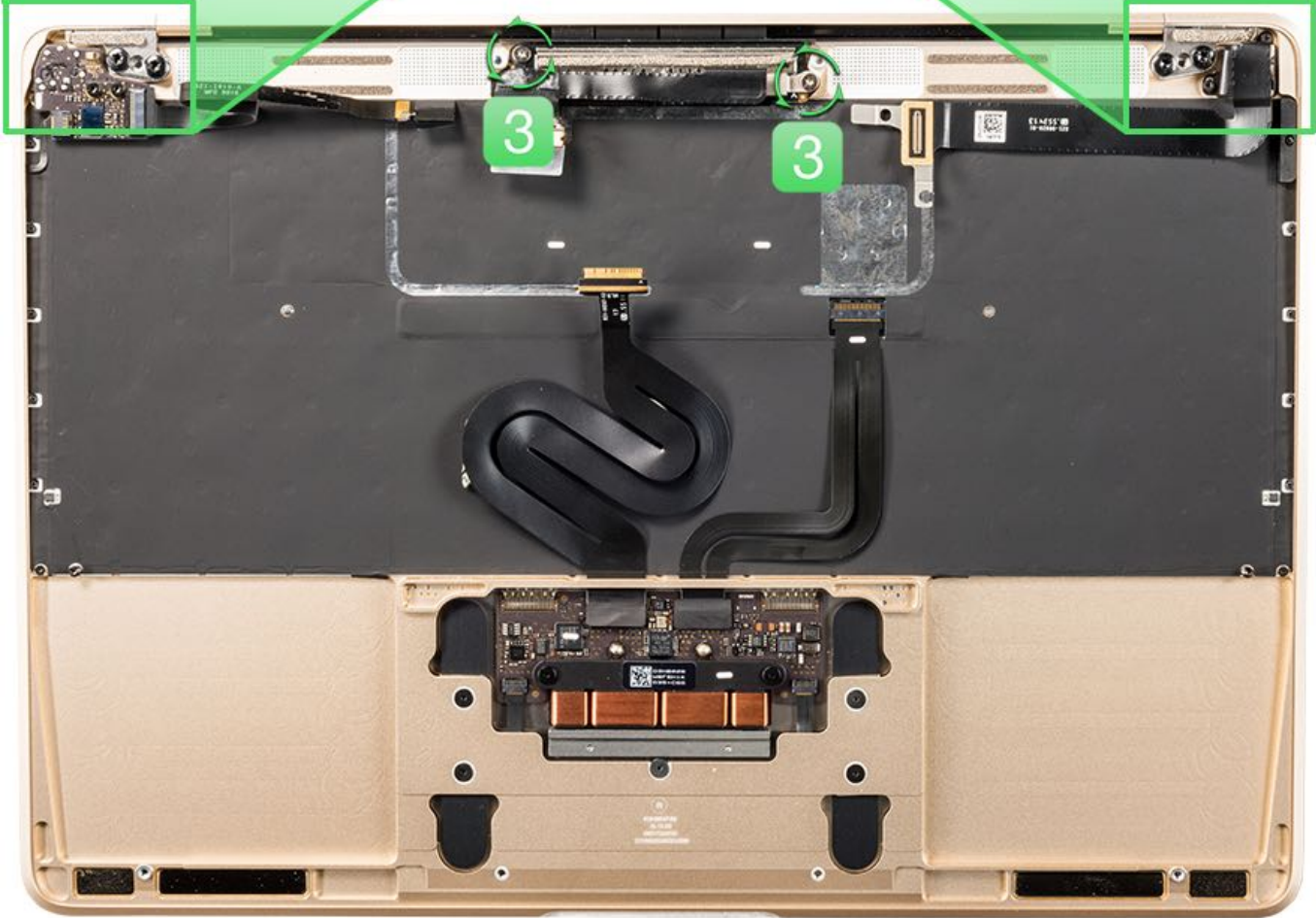
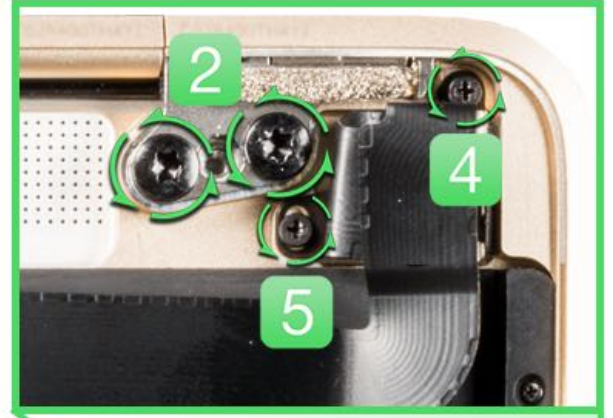
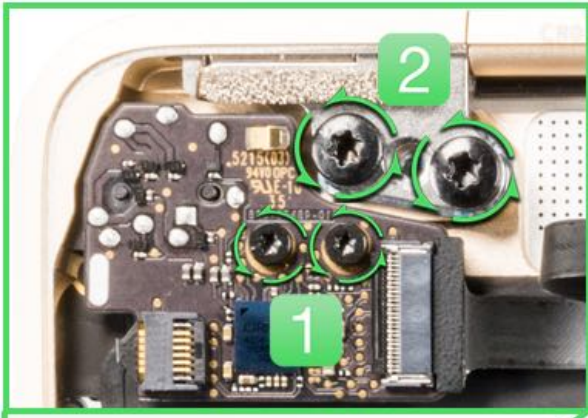
Top Case - Early 2015

1. Audio board - 923-00421
2. Display assembly - 923-00426
3. TCON board - 923-00455
4. I/O board - 923-00424
5. I/O board - 923-00423



Top Case - Early 2016 and 2017

1. Audio board - 923-00421
2. Display assembly - 923-00426
3. TCON board - 923-01015
4. I/O board and flex cable assembly - 923-00424
5. I/O board and flex cable assembly - 923-01011



External Views

External Views for MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

Front View



Port View

A = USB-C port
B = Audio jack



Bottom Case View



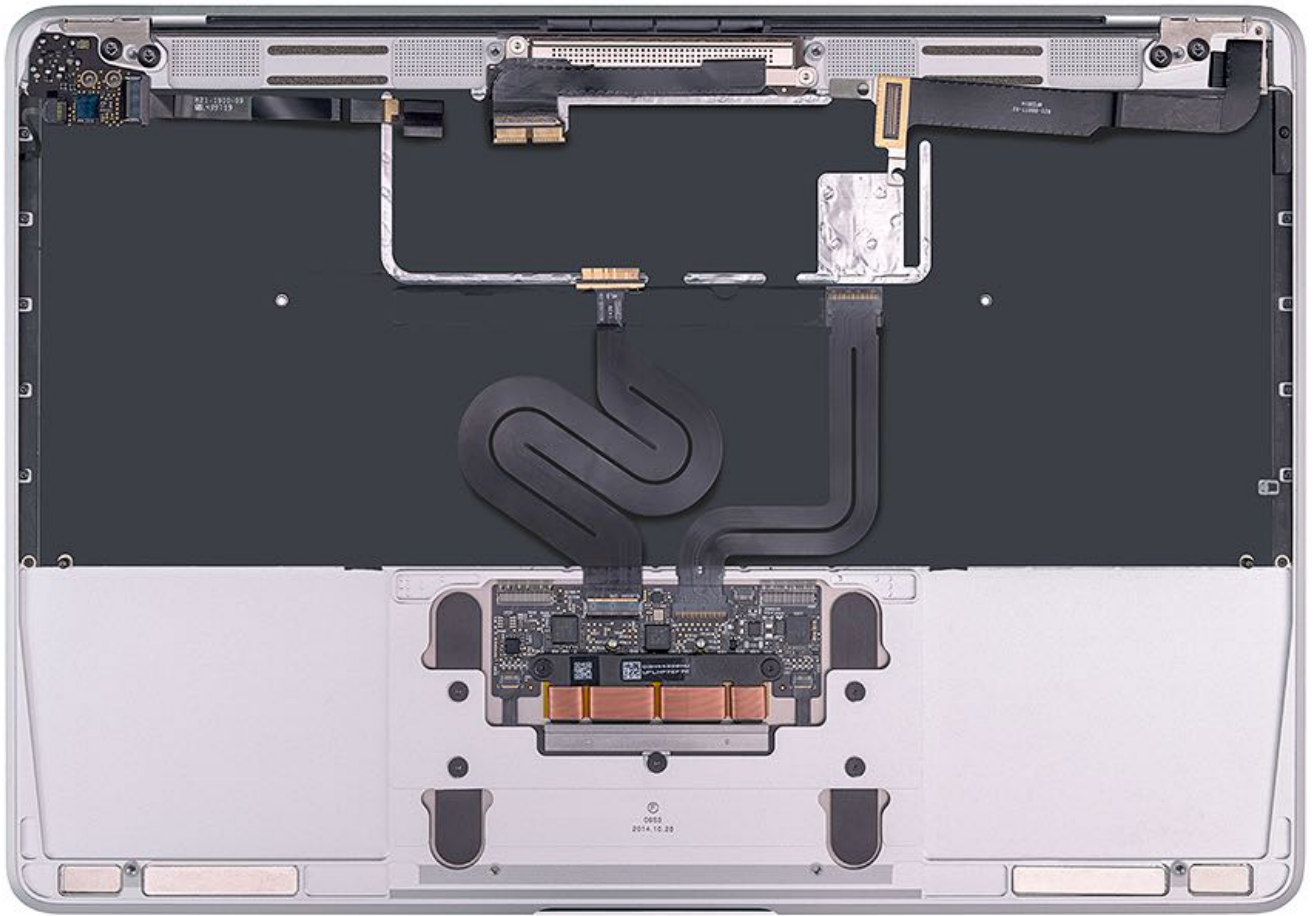
Keyboard and Trackpad View



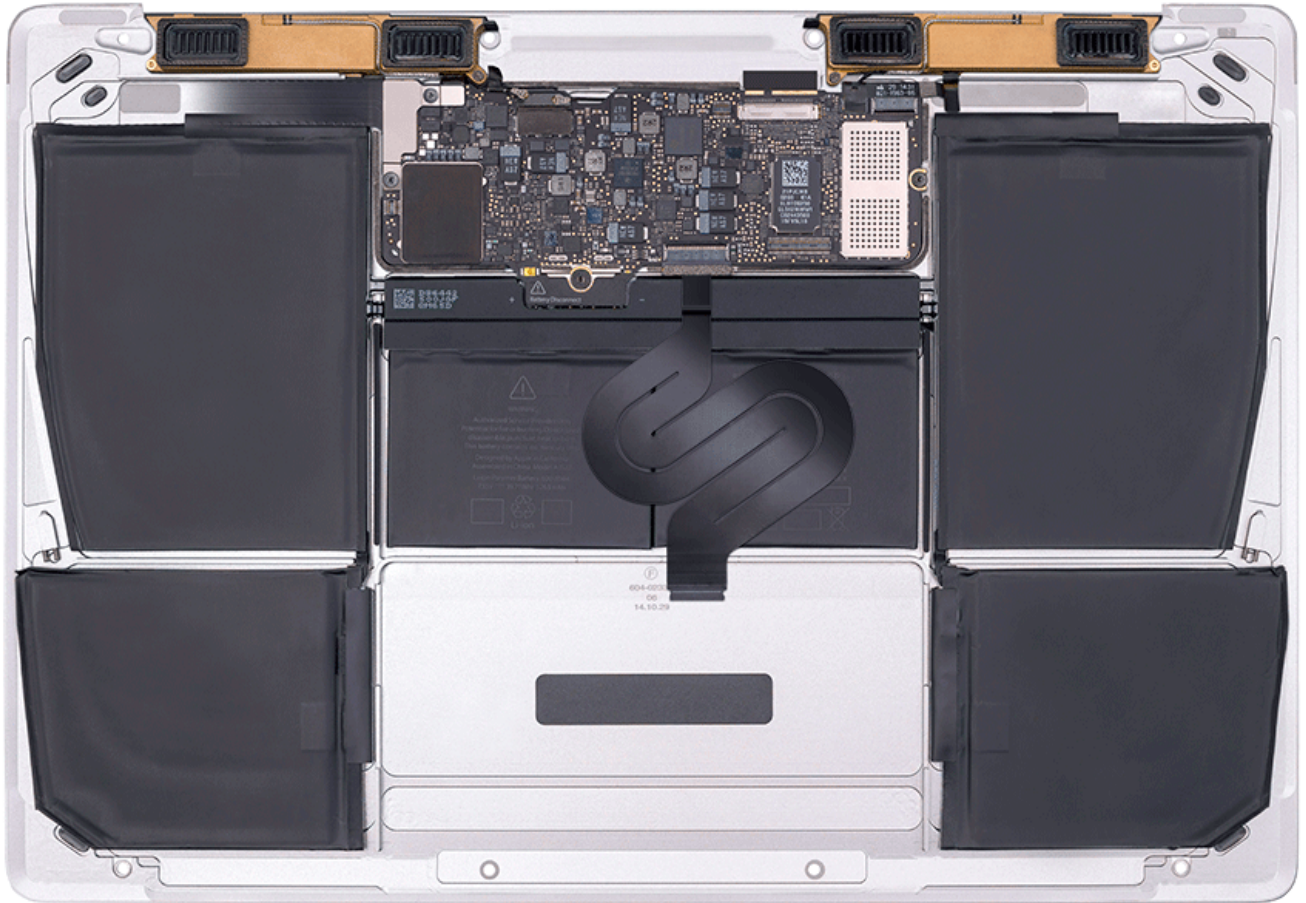
Internal Views

Internal Views for MacBook (Retina, 12-inch, Early 2015)

Top Case with Keyboard



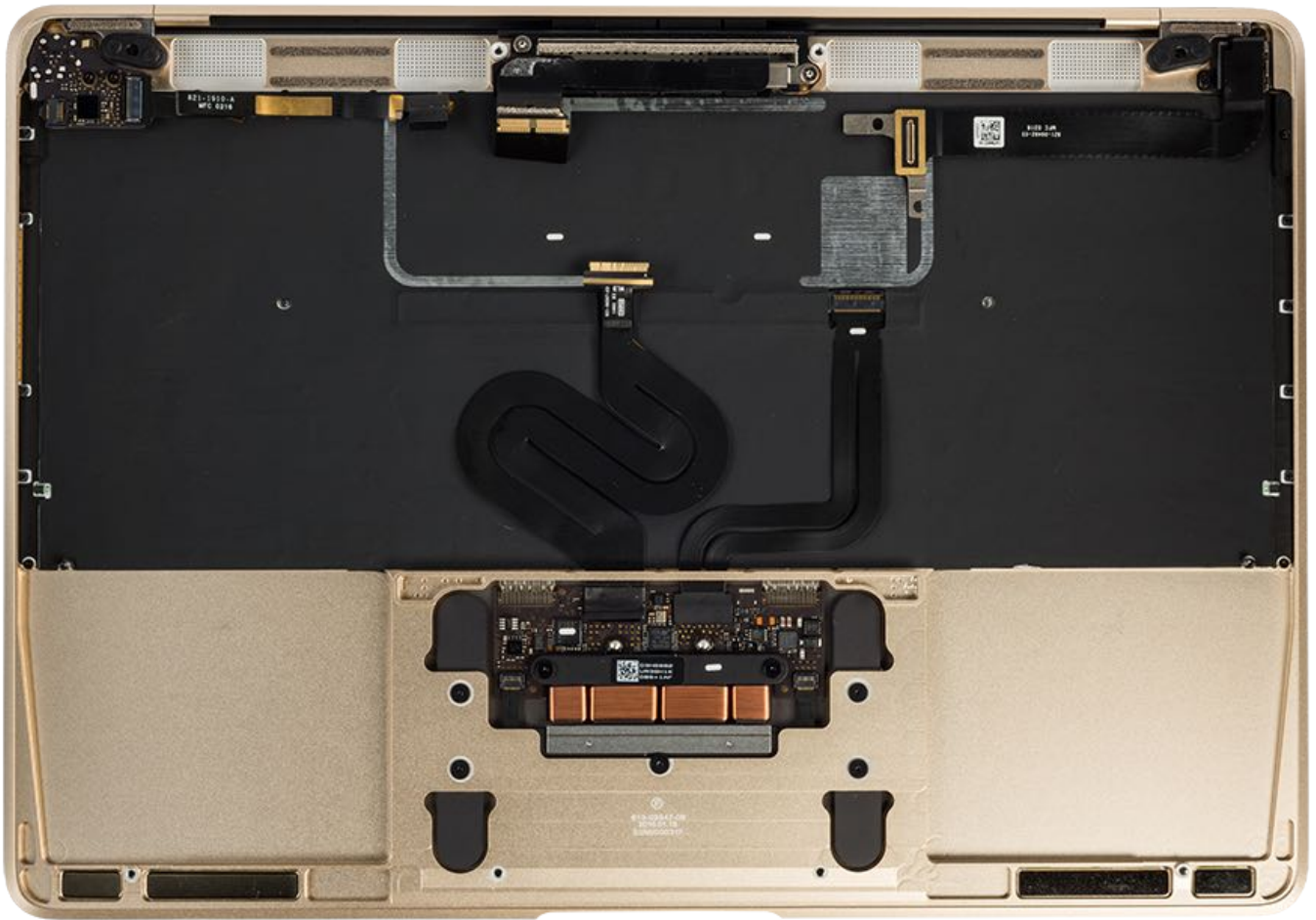
Bottom Case with Battery



Internal Views for MacBook (Retina, 12-inch, Early 2016 and 2017)

Note: MacBook (Retina, 12-inch, 2017) has Ultra Violet Liquid Contact indicators that are not visible without a UV light. For more information on these UV LCIs, refer to article [TP1557: How to Read Liquid Contact Indicators with Ultraviolet \(UV\) Light](#).

Top Case with Keyboard



Bottom Case with Battery

